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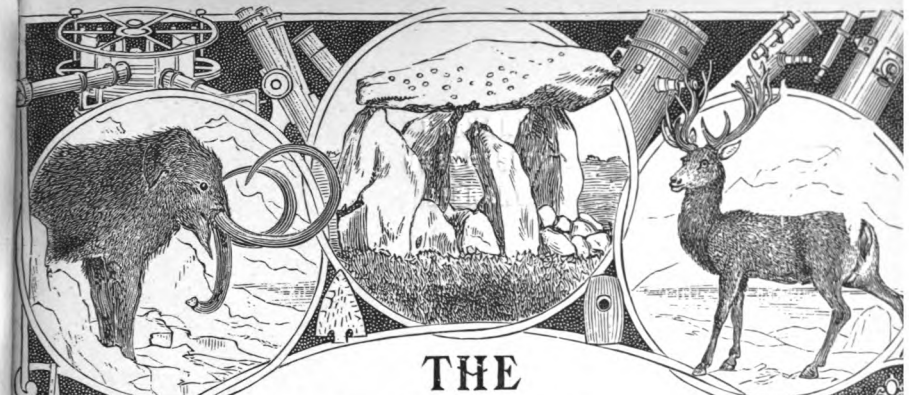

THE MIDLAND NATURALIST

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HISTORY AND MICROSCOPICAL SOCIETY.

EDITED BY
E. W. BADGER & W. J. HARRISON, F.G.S.

"Come forth into the light of things,
Let Nature be your teacher."
Wordsworth.

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PREFACE.

The Editors gladly avail themselves of the opportunity to publicly thank their many able contributors for the valuable papers sent in for publication during the present year. It has been a source of much pleasure to them to have had the privilege of publishing Mr. J. E. Bagnall's "Flora of Warwickshire," the last instalment of which appears in the December number. This important work will no doubt be issued in a complete form before very long, and when it is it will be found to be largely added to, Mr. Bagnall having devoted all his leisure, since the publication began in the Magazine, to the further study and investigation of the Flora of his native county.

The Editors would once more urge their readers to send for publication short notes on natural history topics embodying their personal observations. Communications of this kind would add materially to the value of the "Midland Naturalist."

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Plate 1.

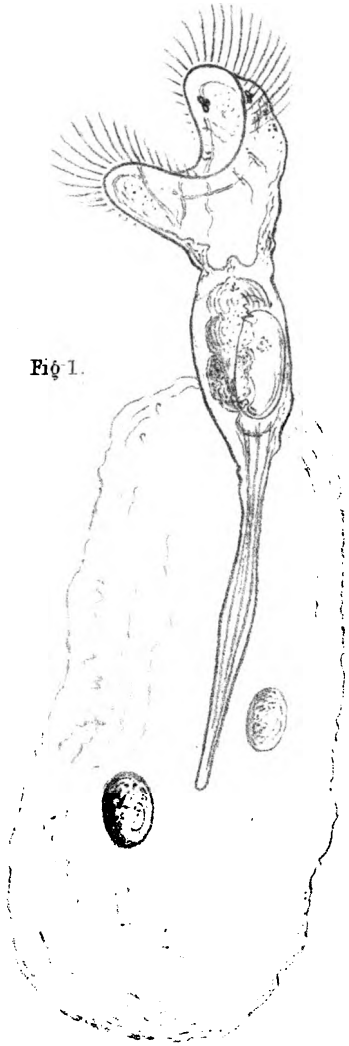

Fig 1.

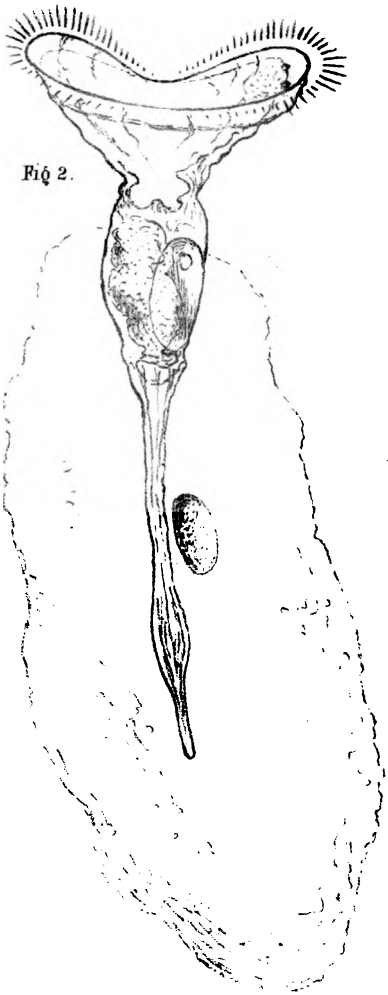

Fig 2.

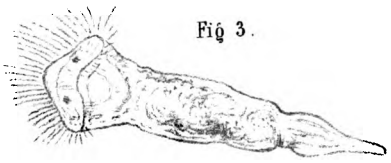

Fig 3.

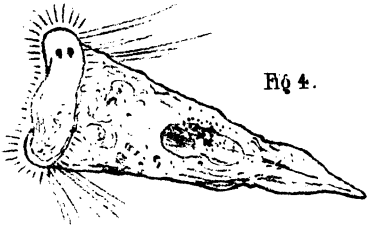

Fig 4.

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T.C.H. Del

FLOSCULARIA MUTABILIS.

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THE MIDLAND NATURALIST.

"Come forth into the light of things,
Let Nature be your teacher."
Wordsworth.

PENMAENMAWR.*

BY T. H. WALLER, B.SC.

Between the villages of Penmaenmawr and Llanfairfechan, on the coast of North Wales, there lies a mass of igneous rock forming the mountain from which the former place takes its name. The seaward face falls so precipitously that to carry the road along the coast the solid rock has had to be cut away, and to allow the railroad to pass a tunnel has been made through the projecting spur. At the height of about 1,000ft. above the sea there is a considerable space of table-land, with a nearly level surface, from which a rough peak rises to about another 500ft. Several quarries have been opened in the mass, as the stone is in considerable demand both for squared setts and for macadamising roads. Of these the most westerly lies just above the village of Llanfairfechan, the floor of the uppermost working being about 900ft. above the sea. In this quarry the sharply jointed character of the rock at once strikes the eye, and it is specially well seen in a large mass which is just now left in the form of a great tooth, at the edge of the floor. It is this jointing which makes it so well adapted for paving setts, and the smooth, flat surfaces are conspicuous in many of the railway bridges of the neighbourhood, distinguishable from artificially worked surfaces only by their rusty-brown skin of weathered stone. The stone does not, so far as I saw it, exhibit any of the gently curved surfaces which are so common in the Rowley Rag; and I saw no instance of the spheroidal weathering which is so characteristic of our local stone, and no approach to columnar structure, unless a very marked and curious—almost stratified—appearance in the extreme edge of the mass towards the west can be considered such.

* Transactions of the Birmingham Natural History and Microscopical Society. Read October 28th, 1884.

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So far as I know, the character of the rock has been mentioned only by Professor Rosenbusch, Mr. J. A. Phillips, and Mr. J. J. Harris Teall. By the former it is stated that "the traps of Penmaenmawr and Conway, in North Wales, belong to the Enstatite-bearing Diabases, of which they are indeed most typical examples." Mr. Phillips, in a paper in the "Quarterly Journal of the Geological Society," 1877, p. 423, gives a detailed account of the varieties to be observed in the mass, giving analyses showing the different stages of alteration, and a description of the mineralogical character as determined microscopically. He considers the mineral associated with the felspar to be hornblende, recognising its slight dichroism but overlooking its rhombic crystallisation. I shall have to refer to this paper again later on. Mr. Teall tells me that he has mentioned the Penmaenmawr stone in his paper on the Whin Sill of the North of England, which he read before the Geological Society in June, but the paper has not yet been published, so I cannot say to what extent he has investigated it. I believe, however, only so far as to confirm the description given by Rosenbusch. The specimens which I obtained while staying at Llanfairfechan this summer are all from the western end of the mass, which, however, Phillips states to be the least altered by weathering.

On making our way towards the quarry we find, as soon as we get clear of the village and come upon any rock, that it is slate, the planes of cleavage (or deposition) dipping towards the igneous mass, though probably the dip is not much affected by the latter. This continues until we arrive at the rough wooden ladders which the quarrymen have fixed in a cleft in the rock to facilitate their laborious journey to and from work. Here we find the igneous rock, and can trace it inwards, gradually changing in character for a few feet. The first we come to is split up into quite thin plates, and this structure, on a large scale, gives its peculiar appearance to the line of cliff which forms the boundary of the mass.

A little further in the rock is very compact, sometimes of a light grey colour, sometimes almost black, but usually containing a quantity of white patches which are either felspar crystals or minerals replacing them. On examining a specimen of this microscopically, we find it to be almost entirely made up of interlacing felspar crystals, with occasional porphyritic ones of larger size, and in the interstices I think we may detect a small amount of residual glassy matter. In one specimen, which, however, I got from a wall in the village, there are dark veins and patches which, on examination, proved to be the parts where the felspar is

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clearest of opaque granular enclosures, due probably to some amount of decomposition. I saw no similar specimen certainly *in situ*, but one or two in such situations that I have no doubt of their being derived from the mountain immediately above them; and one of them occurred in a part which was much more obviously and coarsely crystalline. This border portion has occasionally a well-marked conchoidal fracture; one specimen shows concentric rings, though unfortunately they are not perfect.

In one of my specimens from this fine-grained border of the mass, a very remarkable felspar crystal occurs. It is one of the larger ones—probably of an older generation—which imparts a slightly porphyritic character to this part of the rock; but only one end is visible, and that is of an irregularly oval shape. Over the greater part of the extent of the section there is fairly normal twinning, with angle of 48° between the extinctions of the two sets of lamellæ, which suggests labradorite; but all round the visible edge there is a narrow zone, which is apparently of such different composition that its optical position is quite different from that of the kernel so to speak, although it is obviously continuous with it as to its crystal shape. It extinguishes so very nearly at 45° from the direction of the trace of the twinning plane that it is difficult to say whether it is twinned or not, but I believe not. Strictly speaking, it appears to be made up of a considerable number of very narrow parallel zones, with very slightly different extinction angles.

The ladders already spoken of land us at the level of the quarry, or very nearly so; and from the pathway round the corner of rock which we have to pass, the views over the country westward and Anglesey are very fine. Possibly as we linger here out of sight of the working, we may be surprised to see what seems like a fog drift over us and pass away up the valley to the south. It is, however, dry, and smells dusty, and is the dust arising from the throwing down the seaward face of the mountain the waste stone of the quarry. The quantity so disposed of is enormous, amounting sometimes I was told to 1,800 truck loads per week, and has resulted in the disfiguring fans of bare stones which are so unfortunately conspicuous from Llanfairfechan.

In the quarry we find that we are on the highest of three floors, each of which is being extended further and further into the hill, while the edge of each of the two upper ones is being invaded by the one immediately below it. The stone is worked in the usual manner, the jointing of the rock being taken advantage of to reduce the labour of getting it down.

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After a blast, the men loosen the shaken masses with crowbars, their safety being as far as possible secured by ropes fixed at the top of the face of the rock on which they are working.

An examination of the rock in this section shows that it is composed of felspar, and a rhombic pyroxene, with a very few crystals of augite. The felspar is in the usual elongated forms and is triclinic, but its exact species is not certain; although from the fact that six extinctions were measured betwen 54° and 56°, it is almost certain that labradorite is present. In specimens from this quarry it is pretty fresh and free from decomposition, but in other parts it is not in such good condition. The augite and the enstatite are very similar in appearance, and where the plane of the section has happened to cut across the prism I do not think they are distinguishable. They are both pale in colour—the augite is perhaps a little darker. When the section is more or less parallel to the prism, however, the difference of crystal system is at once shown. Speaking generally, the long narrow sections of enstatite "extinguish" when the length is parallel to the principal plane of one of the nicols prisms, whilst in the case of the monoclinic augite this only happens in the case of the section being in the zone of the orthopinacoid and base. In all other cases, and they are naturally likely to be much the most numerous, the length of the crystal when it "extinguishes" makes an angle with the planes of the nicols, which may vary from 40° downwards. The colours in polarised light which the enstatite shows are paler and more washed out than those of the augite, and the latter does not show the slight dichroism which characterises the former, giving a green or yellow tint according to the position of the crystal section with regard to the principal plane of the polarising prism. Some of the crystals are twinned. When some decomposition has taken place the pyroxenes are replaced by a fibrous green mineral.

Of this constituent of the rock Phillips says:—"The form of these crystals is seldom sufficiently perfect for complete identification, but some of them are strongly dichroic, and their structure is that of hornblende; others, which are very pale in colour, are not distinctly dichroic." The colour he describes as "light greenish brown."

A few flakes of light brown mica are met with here and there, characterised by their strong dichroism and pronounced cleavage.

Irregularly distributed through the stone are certain grey veins and patches of apparently coarser texture, called by the

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quarrymen "spar," and much disliked, as they refuse to "cut" cleanly as the normal stone. I think it likely that Phillips refers to these when he says, "In one of the sections examined a group of felspathic crystals, $\frac{1}{20}$ of an inch in length, which do not exhibit the structure of plagioclase, is enclosed in the finely crystalline base." Of these grey portions I procured a considerable quantity, as I thought the crystals would be sufficiently large to permit of the separation and identification of the felspar. This hope was disappointed, as on account of the minute intergrowth of quartz and felspar, the veins are capital examples of micropegmatite. The felspar also is filled with an opaque white dust, probably due to decomposition. The amount of quartz present seemed so great that an analysis promised to be of interest, and so it turned out, for in addition to showing 6·6 per cent. more silica than the general mass of the stone, as analysed by Mr. Phillips, the prevailing alkali is potash instead of soda. The analyses are as follow:—

	I.	II.
Silica	58·45	65·1
Alumina	17·08	12·9
Ferrous oxide	4·61	4·7
Ferric oxide	0·76	2·0
Manganese oxide	trace	trace
Lime	7·60	4·7
Magnesia	5·15	2·8
Potash	1·02	3·9
Soda	4·25	2·8
Phosphoric acid	trace	
Water	1·07	1·9
	99·99	100·7
Specific gravity	2·94	2·72

I.—By Mr. J. A. Phillips of stone from most westerly quarry.
II.—By T. H. W. of grey vein from the same quarry.

It would thus seem that a considerable proportion of the felspar is orthoclase. The quartz exhibits occasional fluid cavities, with spontaneously moving bubbles. In addition to these two constituents the microscope shows a number of grains of pyroxene and nests of some mineral, apparently a zeolite, forming radiating fans of crystals, which seem all to extinguish parallel to their length, and are, therefore, in all probability orthorhombic. In some cases these blades are so mixed up with quartz as to suggest a simultaneous origin for the two minerals, and the probability is, therefore, that some at any rate of the quartz is of secondary introduction. Phillips queries whether, seeing that the quantity seems to increase with the decomposition of the rock, it may not be due to the progressive crystallization of dissociated silica in

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the process of change. I think, however, that most of that in these grey veins must be contemporaneous with the felspar with which it is so intimately and intricately mingled.

An attempt to determine the nature of this constituent by acting on the powdered stone with acid and separating the constituents was not successful, on account of the large amount of iron which was also dissolved out, as well as on account of the decomposition products of the felspar being attacked.

In the *Neues Jahrbuch* (Beilage Band) of this year is a paper on some rocks of the Southern Black Forest, in which mention is made of certain parts where, along cracks, labradorite is changed into an intimate mixture of a more highly acid felspar, namely an albite, and a zeolite almost perfectly free from alkali. I think, however, that the appearances here are somewhat different, and the bulk analysis of the veins seems to show that this explanation will not hold good.

The greater acidity of these veins, as compared with the mass of the rock, recalls certain grey or red veins in our local Rowley Rag, which Mr. Allport has described to this Society in past years. An analysis has revealed the fact that these also are much more (9%) acid than the bulk of the rock, and moreover, that they contain about 11% of alkalis. I hope, however, to make some recent observations on these the subject of a future paper, so will not further refer to them here.

The order of consolidation, therefore, appears to be the usual one—first the more basic minerals and then the more acid, so that the magma becomes progressively more and more acid in the process of crystallization. This crystallization is accompanied by contraction, which is further increased by the contraction due to the cooling of the mass, so that the formation of cracks is quite a conceivable thing, and it would appear that the still fluid or viscous residuary portion of the mass has filled these, forming the grey veins. It has been ascertained that the glassy base of many rocks is much more acid than the total rock, as in the case of the great Cockfield Dyke, mentioned by Mr. Teall, in his paper on some north country dykes, in the "Quarterly Journal of the Geological Society" for May, 1884, where the general analysis of the rock gave 58·1 per cent. of silica, and 4·2 per cent. of alkalis, while the glassy base, when as perfectly isolated as possible, gave 70·8 silica, and 7·2 alkalis. The analysis of this dyke, as analysed by Mr. Stock, quoted by Mr. Teall, is strikingly similar to that of the rock we have under our notice to-night, except that it has apparently some 5 or 6 per cent. of alumina replaced by peroxide of iron.

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As to the question what we should call the Penmaenmawr rock, we are met by the ever-recurring difficulty that, according to the German petrologists, the geological age is a factor in the question, and I do not know that any indication of the age of the mass is known. It is certainly newer than the Lower Silurian flags and grits through which it has broken its way, but no newer rocks are pierced by it, so that we have a sufficiently wide range. Assuming, however, as is probably the case, that it is at any rate pre-Tertiary, the main mass may be fairly called with Rosenbusch an enstatite diabase, for the structure is in great measure that fully crystalline one characteristic of the diabases, and the prevailing pyroxene is certainly the rhombic one.

REPORT ON MARINE SPONGES*

OBTAINED IN THE OBAN DREDGING EXCURSIONS OF THE BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY IN JULY 1881 AND 1883.

BY H. J. CARTER, ESQ., F.R.S., ETC.

1°.—Specimens collected by the dredge on board the "Curlew" in about 15-30 fths., together with others gathered on the shores of the Island of Kerrera, respectively, in 1881.

The Sponges having been separated from the other *débris* in this collection, and the species of the former from each other, they have been tied up in separate pieces of calico, numbered as follows:—

1.—*Hymeniacidon carnosa*, Bowerbank (Monograph of British Spongiadæ, vol. iii., pl. 36).

2.—*Halichondria Pattersoni*, Bk. (*Ib.*, pl. 46).

3.—*Hymeniacidon suberea*, Bk. (*Ib.*, pl. 36).

4.—*Microciona armata*, Bk. (*Ib.*, pl. 23).

5.—*Halichondria panicea*, Bk. (*Ib.*, pls. 39 and 40).

6.—*Isodictya fucorum*, Bk. (*Ib.*, pl. 56.)

7.—*Débris*, consisting of Shells, Ascidians, Polyzoa, Fuci, &c., &c.

The specimens collected from the shores of the Island of Kerrera are all of one species, viz., *Halichondria panicea*.

* Transactions of the Birmingham Natural History and Microscopical Society. Communicated by Mr. W. R. Hughes, November 11th, 1884.

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Observations. — *Hymeniacidon carnosa*, Bk. = *Suberites* Nardo, *apud* Schmidt, is generally stipitate, but may be simply contracted and sessile towards the base; it contains *no* flesh-spicule.

Halichondria Pattersoni may be known by its dark brown colour and spiculation.

Hymeniacidon suberea, Bk. = *Suberites domuncula*, Nardo, *ap.* Schmidt, generally grows over a gasteropodous shell tenanted by a hermit crab (*Pagurus*), and deposits its ova on the surface of the upper or remaining part of the shell (see Ann. Mag. Nat. History, 1883, vol. xii., p. 36); while it differs among other things from *H. carnosa*, in possessing the little centrally inflated flesh-spicule common also to *H. ficus*, &c. Dr. Bowerbank seems not to have noticed this, as it is omitted in his illustrations of *H. suberea* (*l. c.*) and said (vol. ii., p. 208) to be characteristic only of *H. ficus*, &c. I enclose for your acceptance some dried specimens of *H. suberea* dredged off this place (Budleigh-Salterton, S. coast of Devon), one of which has been divided vertically to show the ova, &c., *in situ*.

Of *Microciona armata*, Bk., there is only one specimen which has grown over the ventral valve of a Brachiopod (? species).

Halichondria panicea, Bk. = *Amorphina*, Schmidt, is a deep-sea as well as a littoral species, apparently the most plentiful of all, all over the world; in which the only difference appears to be in the size of the spicules which are smallest in the latter.

Isodictya fucorum, Bk. = *Halichondria fucorum*, Johnston; may be known by its habit of growing over the stems of Fuci, together with its spiculation, in which there is a little equianchorate flesh-spicule of the navicula-shaped kind. There is very little difference between this and *Isodictya alderi*, Bk., as I have learnt from an examination of the type specimens of these species now in the British Museum.

Of the *Débris* I can add nothing to what has been above stated.

Thus, in point of general classification, *Halichondria panicea* and *H. Pattersoni*, respectively, belong to the groups Nos. 1 and 6 in the first family of my order Holorhaphidota, viz., the Renierida (Ann. Mag. Nat. History, 1875, vol. xvi., pp. 177 and 190). *Hymeniacidon carnosa* and *H. suberea* to the second family, viz., the Suberitida. *Microciona* belongs to the Microcionina in my order Echinonemata, and here also I should be inclined to place *Isodictya fucorum* chiefly on account of the form of its skeletal spicules and the presence of the little navicula-shaped equianchorate.

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2°.—Specimens collected by the dredge on board the "Aerolite" steam-launch in 15-20 fths. in 1883.

These have been treated precisely in the same way as the dredgings on board the "Curlew" above mentioned, and the species tied up separately in bits of muslin, numbered as follows:—

1.—*Hymeniacidon carnosa*, Bk.
2.—*Halichondria Pattersoni*, Bk.
3.—*Hymeniacidon suberea*, Bk.
4.—*Halichondria panicea*, Bk.
5.—*Isodictya fucorum*, Bk.

Calcareous Sponges.

6.—*Grantia compressa*, Bk., (*Op. cit.*, vol. iii., pl. 1), and *Grantia ciliata*, Bk., (*Ib.*, pl. 2,) growing together on small Fuci.

7.—*Leucosolenia botryoides*, Bk., (*Ib.*, pl. 3.)
8.—*Leucosolenia contorta*, Bk., (*Ib.*, pl. 3.)
9.—*Débris*, contents similar to those above mentioned.

Observations.—Although there is no specimen of *Microciona* here, all the rest of the species obtained in the dredging of 1881 appear in that of 1883, so that the "observations" already made on *them* are equally applicable to those of 1881.

But, in addition to these species, all of which are provided with *siliceous* spicules, there are several others here whose spicules, *minerally*, are compossed of carbonate of lime, *i.e.*, the so-called "Calcareous Sponges," of which it might be observed that:—

Grantia compressa may be known by its compressed form, smooth surface and unfringed or naked mouth, growing together on small Fuci here, with *Grantia ciliata*, from which again it may be distinguished by the rough surface and fringed mouth of the latter.

Leucosolenia botryoides, a branching little sponge, requiring the aid of a two-inch focus lens to be well seen; growing in small patches, with the ends of the branches terminating in a little sacciform head respectively; on small Fuci.

Leucosolenia contorta = *Clathrina*, Gray = *Ascetta*, Haeckel; is represented by one specimen only. It grows abundantly on the rocks between tides, at this place, and an account of it may be found in the Ann. Mag. Nat. History for 1884, vol. xiv., p. 17, under its original name of *Spongia coriacea*, Montagu.

In short, all four species, with many others, may often be found growing together on the same Fucus or piece of rock.

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I also enclose for the kind acceptance of the Society, a specimen, with slice to show its structure, of *Suberites Wilsoni*, a beautifully carmine-coloured sponge which occurs in pyramidal masses, sometimes upwards of fifteen inches high, on the south coast of Australia, and which, among other species, was sent to me by J. Bracebridge Wilson, M.A., F.L.S., of the Church of England Grammar School, Geelong, Victoria Colony, after whom I have named and described it.

It is sufficiently different from the *Alcyonium purpureum* of Lamarck, which also came from Australia, as I learn from the type-specimen of the latter in the British Museum, to constitute a new species, and was dredged up by Mr. Wilson, with the rest, off Port Philip Heads in about nineteen fathoms.

ON "THE STRUCTURE OF MOSSES."

BY F. T. MOTT.

DIVIDING the vegetable kingdom primarily into Phænogams and Cryptogams, and subdividing the Cryptogams into three classes, viz., Vascular Acrogens, Cellular Acrogens, and Thallogens, the mosses stand in the group of Cellular Acrogens, and at the head of that group. They are the most highly organised of all the purely cellular plants. Below them are the Hepaticæ, Lichens, Fungi, and Algæ; above them the vascular Cryptogams, Lycopods, Horsetails, and Ferns, and then the great host of the Phænogams.

As Cellular Acrogens they should consist of soft cellular tissue, increasing only at the growing points. But Nature draws no hard and fast lines. She is infinite and we are finite, and our attempts to map out the infinite are always baffled.

These highest Cellular Acrogens are *not* always cellular. There is in the stems of many species a central thread of narrow elongated cells approaching to fibro-vascular tissue, and the cortical cells are often thickened with woody matter so as to form a rigid bark. There is another point in which Mosses are more nearly allied to the orders above them than to those below them—this is in the phenomenon of alter-

* Transactions of Section D of the Leicester Literary and Philosophical Society. Read February 19th, 1884.

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nation of generations. The most marked distinction between alternate generations is that between the sexual and the asexual. In the very lowest forms of algæ and fungi there is no sexual generation and no alternation. All the cells are similar, and propagate by simple fission without fertilisation. In the higher forms there is a sexual generation, sometimes regularly alternating with an asexual one, sometimes coming in at more distant intervals, and sometimes there is a third generation different from either. But mosses, in common with all the vascular cryptogams above them, have an unchangeable succession of sexual and asexual generations.

The germinating spore produces a branching plant, with stem and leaves, a true cormophyte—κορμος φυτον—a plant with a stem. This is the sexual generation, bearing the antheridia which fertilise the archegonia. But the fertilised archegonium does not develop into a seed or a true fruit. It gives rise to a slender thread-like branch, which afterwards enlarges at the end into a thallus, on the surface of which arise spores requiring no fertilisation. This is the asexual generation. The thallus in mosses takes the form of a capsule, and is commonly called a fruit; but morphologically it is the same as the spore-bearing thallus of the thallophytes —the fungi and algæ—and not homologous with the fruit of phœnogams.

Thus in Mosses the cormophyte generation is sexual and the thallophyte asexual, while in ferns the cormophyte or stem and leaf form is asexual, the spore bearing frond; and the thallophyte—the pro-thallus, is the sexual generation bearing antheridia and archegonia.

When our present systems of classification were founded, these alternate generations were but little understood, and were not regarded. But they seem to be so fundamental to the different modes of growth and development that they will probably take a conspicuous place in the classifications of the future.

Now let us trace the various stages of growth in a moss. When a spore germinates, it produces first a branching septate thread on the surface of the ground, the cells of which contain green chlorophyll. This is called the *protonema*. From different parts of this thread leaf-buds arise, which grow at the points into stems producing leaves as they lengthen.

The leaves are sometimes distichou, that is in two opposite rows, but more often alternate and in spirals of different formulæ, which cause the leaves to stand in three, five, or eight rows.

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The leaves of mosses are always sessile and broad based. In shape they vary from rounded to very narrow and pointed, but are never lobed or divided. They have no branching veins, but frequently have a midrib, sometimes two, and are often finely toothed on the edges.

The stems in one section are mostly upright and slightly branched. In another mostly decumbent and very much branched in a pinnate fashion.

These two sections are very distinct, and form well marked divisions of the order.

The upright mosses bear their fruit at the points of the stems and are called *acrocarpous*. The much branched creeping mosses bear their fruit along the sides of the stems and are called *pleurocarpous*.

Now we come to the fructification. At all times of the year there are some mosses bearing their fruits, but the spring and the autumn are the most prolific. Mosses as a rule love moisture, and they get most of it at these seasons.

Some time before the appearance of the fruit, the antheridia and archegonia are formed hidden in the axils of the leaves, or among the tuft of leaves at the top of the stem. These organs are very minute, and have only been known to exist as sexual organs within the last fifty years. They occur sometimes both together on the same plant, and sometimes each on a separate plant.

The antheridia are mostly long oval bodies filled with ciliated antherozoids which have a power of locomotion in water. The archegonia are rounded at the base and tubular above, and the antherozoids pass down the tube to reach and fertilise the oosphere.

After fertilisation the oosphere develops into a straight stalk which grows vigorously upwards, tears asunder the tube or neck of the archegonium, and carries away the top of it in the form of a cap called the calyptra. Within this cap the top of the stalk begins to swell, and gradually grows into a hollow capsule of very interesting construction. In the centre is a little pillar called the *columella*, round which the spores cluster thickly. Surrounding the mouth are one or two circlets of fine teeth called the peristome, sometimes brightly coloured, and often strongly hygrometric, opening and closing with changes of moisture in the air. Above the peristome is the lid, or moveable cover of the capsule, which has often a long beak, and which drops off when the capsule is ripe to let the spores fall out. Above the lid is the calyptra, a kind of hood or penthouse protecting the young capsule, which at last outgrows it and pushes it off, leaving the lid exposed.

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The time occupied from the appearance of the antheridia and archegonia to the ripening of the spores varies from about two months to ten or twelve in different species. When the spores are ripe they have to be discharged from the capsule. This is mostly effected by the capsule bending downwards. Sometimes the stalk bends, sometimes the capsule itself becomes arched. But where the capsule remains erect a jerk is produced either by the elasticity of the peristome or by a sudden twist of the stalk, and the spores are so small and light that a very slight jerk throws them out as a fine floating dust. Then they find their way to the moist earth, and give rise to a new protonema.

Some mosses—two at least of our common species—have another method of asexual propagation, by the production of gemmæ, which are not single cells like spores, but clusters of cells produced on special stalks, and which also give rise to a protonema.

In this short sketch I have omitted many exceptions and specialities of aberrant genera, my object being merely to give a general outline of the subject by way of introduction to the examination of the living specimens.

LES PLANTES DES ALPES.*

The name of M. Correvon is already familiar to readers of the "Gardeners' Chronicle" as the writer of some useful notes on the cultivation of alpine plants, founded on an experience gained whilst curator of the Botanic Gardens at Geneva. He has now given us, in French, a small book on the same subject, containing some 260 pages of post 8vo., printed in large clear type.

The Jardin d'Acclimatation of Geneva was instituted last year, and seems likely to play an important part in the distribution of alpine plants. M. Correvon tells us that a few lovers of flowers, amongst whom he seems to have been the leading spirit, being horrified at the enormous number of alpine plants which are every year dug up in the Alps by tourists of all nations, and taken home when in full flower only to die, thought this the best remedy. "This new horticultural establishment," he says, "has for its object the raising of large quantities of the choicest alpines, to offer them to amateurs at a low price. We hope to be able to supply foreign nurserymen with these plants from seed, so they will have no more occasion to get their stock from the mountains."

After a hundred pages about the origin, and distribution, and native conditions of alpine plants, we come to the more practical part of the book, which concerns their selection and their cultivation. The flora of the Alps, we are reminded, is the richest in the world,

* Les Plantes des Alpes. By H. Correvon, Directeur de Jardin d'Acclimatation, Genève.

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containing about 230 species of flowering plants, which are found nowhere else. M. Correvon estimates that out of about 900 species of flowers found in the alpine districts upwards of 700 are worth cultivating. About fifty of these have hitherto defied all attempts to tame them, but even of these M. Correvon does not despair. Perhaps half of the remainder may strictly be called mountain or rock plants, but besides these we have a catalogue of all the best rock plants in cultivation from all the mountains in the world. These are all arranged according to their botanical orders, and the soil and aspect in which each is to be planted are given. We extract two examples of the way in which the directions are given:—

Polygala chamæbuxus.—A somewhat capricious plant; sometimes it grows very well in ordinary soil, provided it has shade, whilst in other cases no care or precautions will make it grow. In general it prefers bog soil, moisture, and sunshine. I have raised it from seed, and cultivate it in light soil mixed with sphagnum.

Gypsophila repens.—Indigenous to limestone rocks, but it grows so readily that one meets with it everywhere, even on granite. It is one of the best of rockery plants; it flowers from May to November, and suits itself to all soils and all aspects. It is also a useful basket plant, because of its long hanging branches, which are very effective when loaded with flowers.

These extracts are sufficient to show the style of the book; for the cultivation of some plants we have more precise and detailed directions. All who grow alpines know how difficult a plant Soldanella alpina is—not to make grow, but to make flower, and it is interesting to read the minute details of the plan by which M. Correvon succeeded in making it flower well.

The chapters which deal with the formation of rockeries and alpine beds cannot fail to be read with interest. We are rightly told that many alpines may be grown quite as successfully in level borders as on steep rockeries, provided the conditions of drainage and soil are suitable; if the soil is heavy and wet these defects may be remedied by the bed being raised two feet above the ground level, though it is not wet, but stagnant wet, which hurts alpines. We cannot, however, entirely agree with M. Correvon in the directions he gives for the formation of a rockery, when he speaks of cementing the stones together. Stones for rockery ought to be so fitted as to interlock firmly without any possibility of their either sinking or slipping, and ought not to depend on the soil, or on mortar, for being kept in their places. There is one more point to which we would direct the special attention of those interested in the growth of alpines—the way in which old walls may be utilised for this purpose. In the concluding chapter of the work we have this subject treated of in such a way as to make us wish we could convert all our boundary walls into alpine gardens. We are told on the last page that the growth of alpines is "more a question of suitable conditions of soil than anything else," and we may say that every year's experience tends more to convince us of the truth of this maxim.—*Gardener's Chronicle.*

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REGIONS WHERE CULTIVATED PLANTS ORIGINATED.

BY ALPHONSE DE CANDOLLE.

In the beginning of the nineteenth century the origin of most of our cultivated species was unknown. Linnæus made no efforts to discover it, and subsequent authors merely copied the vague or erroneous expressions by which he indicated their habitations. Alexander von Humboldt expressed the true state of the science in 1807 when he said, "The origin, the first home of the plants most useful to man, and which have accompanied him from the remotest epochs, is a secret as impenetrable as the dwelling of all our domestic animals. . . We do not know what region produced spontaneously wheat, barley, oats, and rye. The plants which constitute the natural riches of all the inhabitants of the tropics—the banana, the papaw, the manioc, and maize, have never been found in a wild state. The potato presents the same phenomenon." *

At the present day, if a few cultivated species have not yet been seen in a wild state, this is not the case with the immense majority. We know, at least, most frequently, from what country they first came. This was already the result of my work of 1855,† which modern more extensive research has confirmed in almost all points. This research has been applied to 247 species cultivated on a large scale by agriculturists or in kitchen gardens and orchards. I might have added a few rarely cultivated, or but little known, or of which the cultivation has been abandoned; but the statistical results would have been the same.

Out of the 247 species which I have studied, the old world has furnished 199, America 45, and three are still uncertain.

No species was common to the tropical and austral regions of the two hemispheres before cultivation. *Allium schænoprasum*, the hop (*Humulus tupulus*), the strawberry (*Fragaria vesca*), the currant (*Ribes rubrum*), the chestnut (*Castanea vulgaris*), and the mushroom (*Agaricus campestris*) were common to the northern regions of the old and new worlds. I have reckoned them among the species of the old world, since their principal habitation is there, and there they were first cultivated.

* "Essai sur la Géographie des Plantes," p. 28.

† A. de Candolle, "Géogr. Bot. Raisonnée."

‡ Common Haricot *Phaseolus vulgaris*, Musk gourd *Curcubita moschata*, and the Fig-leaved gourd *M. ficifolia*.

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A great number of species originated at once in Europe and Western Asia, in Europe and Siberia, in the Mediterranean basin and Western Asia, in India and the Asiatic archipelago, in the West Indies and Mexico, in these two regions and Columbia, in Peru and Brazil or in Peru and Columbia, &c. This is a proof of the impossibility of subdividing the continents and of classing the islands in well-defined natural regions. Whatever be the method of division there will always be species common to two, three, four, or more regions, and others confined to a small portion of a single country.

A noteworthy fact is the absence in some countries of indigenous cultivated plants. For instance, we have none from the arctic or antarctic regions, where, it is true, the floras consist of but few species. The United States, in spite of their vast territory, which will soon support hundreds of millions of inhabitants, only yields as nutritious plants worth cultivating the Jerusalem artichoke and the gourds. *Zizana æquatic*, which the natives gathered wild, is a grass too inferior to our cereals and to rice to make it worth the trouble of planting it. They had a few bulbs and edible berries but they have not tried to cultivate them, having early received the maize, which was worth far more.

Patagonia and the Cape have not furnished a single species; Australia and New Zealand have furnished one tree, *Eucalyptus globulus*, and a vegetable, not very nutritious, the *Tetragonia*. Their floras were entirely wanting in graminæ similar to the cereals, in leguminous plants with edible seeds, in cruciferæ with fleshy roots. In the moist tropical region of Australia rice and *Alocasia macrorhiza* have been found wild, or perhaps naturalised, but the greater part of the country suffers too much from drought to allow these species to become widely diffused.

In general the austral regions had very few annuals, and among their restricted number none offered evident advantages. Now annual species are the easiest to cultivate. They have played a great part in the ancient agriculture of other countries.

In short, the original distribution of cultivated species was very unequal. It had no proportion with the needs of man or the extent of territory.

[The foregoing article is extracted from M. Alphonse de Candolle's admirable new book on the "Origin of Cultivated Plants"—the latest volume of the "International Scientific Series," published by Kegan Paul, Trench, and Co.—a volume of moderate size, embodying the results of much profound research, extending over many years, and containing much that is singularly interesting to botanists. We cordially commend it to all our readers, as deserving a place in their libraries.—Eds. *Mid. Nat.*]

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BREAKING OF THE MERES,
SIMULATED BY AN EXCESSIVE DEVELOPMENT OF *UROGLENA VOLVOX*.

BY WM. SOUTHALL, F.L.S.

The interesting phenomena called the "Breaking of the Meres" is, I believe, usually explained as resulting from an excessive multiplication and growth of various algæ; therefore I suppose there is no direct comparison between that and the occurrence I am about to describe, which had an animal origin, but as some of the appearances were to a certain extent similar, the parallel between the two naturally suggested itself.

This apparently sudden and excessive development of one of the Infusoria occurred in a pond at Edgbaston, having the extent of about a quarter of an acre, rather deep, and nearly surrounded by trees; no stream runs into it, and it is fed by springs. It communicates with another pool at a lower level, but in dry weather the water does not run over but only percolates through the bank.

I noticed about the middle of May, 1883, that the water had assumed a deep vivid green colour, and regret that I did not examine it to ascertain the cause. Rather before the end of the month the whole of the water became almost suddenly of a light reddish brown colour, very opaque, and almost exactly like that we see in the gravel pits in this neighbourhood after a storm of rain. It had a curious effect amongst the green trees, and singularly enough the lower pool was not in the least affected, retaining its original colour and transparency. A tumblerful of the affected water showed a large population of lively swimming bodies that I at first took to be *Volvox globator*, but I was then unable to determine their proper identity. I left home on the 1st of June, and was informed that it was some weeks before the water resumed its usual appearance.

This year I looked out anxiously for a reappearance, and early in May found the same organisms were easily observed in a glass of the water. After a short time, however, they entirely disappeared, whether owing to a change of wind or temperature I cannot say, but I strained a large quantity of water without finding any. After a while the vivid green colour again showed itself in large patches, and they returned and again became pretty plentiful, but I could not connect the green colour in any way with the organisms, as their colour was a dull greenish brown. I now found that they were not plants, but animals—*Uroglena Volvox*—one of the

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Infusoria. It is curious, however, to note that a number of them in a tumbler produced in the light a large crop of bubbles of gas after the fashion of submerged plants. There was not, however, much appearance of chlorophyll to account for this. I regret it was not tested to determine its nature, which I supposed at the time to be oxygen. This organism was considered to be a plant, at all events as recently as the date of the third edition of the Micrographical Dictionary, about nine years since, and I for some time looked for it amongst the algæ. I sent specimens to some of my friends for determination, but in no case did they bear the shaking undergone in carriage, having, though sent in considerable numbers, entirely disappeared in a short time. I took, however, no precautions, except filling the bottles quite full. The figure in Saville Kent's great work is correct, but hardly doing it justice and wanting in details. I observed numerous double specimens, the shape of a short old-fashioned silk purse, and which seemed to swim as freely as the globular single families.

Whether this is a species frequently met with or not I do not know ; not being so beautiful as *Volvox globator*, it may not receive a comparative meed of notice ; but, at all events, it seemed to me that its occurrence in countless millions, as in the present case, and the singular effects produced thereby were worthy of record.

THE FLORA OF WARWICKSHIRE.

AN ACCOUNT OF THE FLOWERING PLANTS AND FERNS OF THE COUNTY OF WARWICK.

BY JAMES E. BAGNALL.

(Continued from page 327, Vol. VII.)

CYPERACEÆ (*continued*).

ERIOPHORUM.

E. vaginatum, *Linn. Hare's-tail Cotton Grass.*

Native: In bogs and boggy heath lands. Rare. March.

I. Bannersley Pool! Coleshill Bog! *Bree*, *Purt.* i, 66, Packington! *Aylesford*, *B.G.*, 633. Sutton Park, abundant; marshy coppice near Packington; near Honily.

II. Shrewley Pool, *H.B.*

E. angustifolium, *Roth. Common Cotton Grass.*

Native: In bogs and boggy heath lands. Rather rare. April, May.

I. (*E. polystachion.*) Packington, *Aylesford*, *B.G.*, 633. Bogs about Polesworth, *J.P.*, *M.S. note*, *B.G.* Sutton! *Freeman*, *Phyt.*, i, 261. Sutton Park; Coleshill Pool and bog; marshy coppice near Packington; sand quarry, Cornels End; Bradnock's Marsh.

II. Near Honily Mill, *H.B.*; pool near Tile Hill Wood, 1882; Shrewley Pool.

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CAREX.

C. dioica, *Linn. Creeping Diœcious Sedge.*
Native: On peaty and boggy heaths. Rare. June, July.
I. Abundant in Sutton Park; marshy heath land, Ballard's Green, near Arley.
II. Styvichall Pool, *T. K., Herb. Perry.*

C. pulicaris, *Linn. Flea Sedge. Harpoon Carex.*
Native: On boggy and damp peaty heaths. Rare. June, July.
I. Sutton Park, abundant; Ballard's Green, near Arley; Cornel's End.
II. In some marshy ground near Rugby, *Purt.*, ii, 441; banks of canal near Hill Moreton Locks, *R. S. R.*, 1880.

C. disticha, *Huds. Soft Brown Sedge.*
Native: In damp pastures, and near pools and rivers. Local. June, July.
I. Honily, *Y. and B.;* Sutton Park, rare; abundant in Water Works Ground, Witton Lane; by the Cole, near Coleshill Mill; Bradnock's Marsh.
II. In a thicket in the road from Dunnington to Abbott's Moreton, *Purt.*, ii, 442; near Chesterton; Rounsel Lane; Hill Wootton, *Herb. Perry;* Blue Boar Lane, and near Cosford, Rugby, *L. Cumming;* Rowington Canal Bank; marshy heath land, near Sowe Waste Canal.

C. teretiuscula, *Good. Lesser Panicled Sedge.*
Native: In spongy bogs. Very rare. June, July.
"38. Warwick. Kirk. Cat." *Top. Bot.*, 437.
Var., *b. Ehrhartiani,* Hoppe. Very rare.
I. Sutton Park, very abundant, 1883-4.

C. paniculata, *Linn. Greater Panicled Sedge.*
Native: Near rivers, canals, pools, and in damp woods. Locally common. May to July.
I. Sutton Park, abundant; canal side near Curdworth; Water Works Ground, Witton Lane; Marston Green; Olton Pool; Henfield, near Knowle; canal bank, near Temple Balsall; Knowle Canal bank; Bradnock's Marsh; Earl's Wood.
II. Honily; Radford, *Y. and B.;* Bearley Bushes; Hatton Canal; Binley Common; canal, near Newbould-on-Avon; Farnborough.

C. vulpina, *Linn. Great Sedge.*
Native: In ditches, marshes, and damp meadows. Common. May to August. Area general.

C. muricata, *Linn. Greater Prickly Sedge.*
Native: On banks, near canals, waste heathy spots, &c. Common. May to July. Area general.
b. pseudo-divulsa. Rare.
II. Near Haywoods.

C. divulsa, *Good. Grey Sedge.*
Native: On banks and heathy roadsides. Local. May to July.
I. Near Blythe Hall, Coleshill; Bannersley Rough; heathy roadsides, near Barston Marsh; heathy waysides, Blythe Bridge, near Solihull.
II. Harbury, *H. B.;* on a hedge bank between Wixford and Pophills, *Purt.*, ii, 413; Honington, *Newb.;* Iron Cross, near Wixford; Salford Priors; Red Hill, near Alcester; near Morton Bagot; Little Alne; Aston Cantlow; Studley, near the railway station; Baddesley Clinton.

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C. echinata, *Murr.* (*C. stellulata*, Good.) *Little Prickly Sedge.*
Native: In bogs, marshes, and damp woods. Local and rare. May to August.
I. About Middleton! *Ray, Cat.*, p. 150; Coleshill Bog! *Ick. Anal.*, 1837; Bradnock's Hayes, near Little Sutton; School Rough, Marston Green; Coleshill Pool; pasture by Olton Pool; Hill Bickenhill; sand quarry, Cornel's End; near Berkswell; damp pastures, near Packwood Mill; Earl's Wood; Forshaw Heath.
II. Haywoods!; Milverton, *Y. and B.*; marsh on Binley Common.

C. remota, *Linn. Distant-spiked Sedge.*
Native: On damp banks by ditches, drains, &c. Common. June, July. Area general.

C. axillaris, *Good. Axillary Sedge.*
Native: In damp copses and on damp banks. Rare. May to July.
I. Abundant in an osier plantation near Solihull, 1872-8; abundant on damp banks near Hampton-in-Arden, 1881; near Kingsbury Railway Station, lane to Hurley, 1883.
II. Near Rounsel Lane, Kenilworth, *H. B., Herb. Brit. Mus.* Extinct. In abundance near Ansty, Coventry, 1883.

C. Boenninghauseniana, *Weihe. Bönninghausen's Sedge.*
Native: In bushy pits. Very rare. July.
II. Bushy pit near Rounsel Lane, Kenilworth, *H. B.* Extinct.

C. elongata, *Linn. Elongated Sedge.*
Native: On damp hedge banks. Very rare, June, July.
I. Abundant in several places near Hampton-in-Arden; abundant in pool near Birchey Leasowes, Shirley.

C. canescens, *Linn.* (*C. curta*, Good.) *White Sedge.*
Native: In boggy meadows, near pools, and on damp banks. Very local. May, June.
I. In a pool not far from Middleton towards Coleshill, *Ray, Cat.*, ed. 1, p. 147; Sutton Park, near several of the pools; on the shores of Coleshill Pool; marshy meadow near Earl's Wood, abundant, 1883.

C. leporina, *Linn.* (*C. ovalis*, Good.) *Oval-spiked Sedge.*
Native: In turfy bogs, damp heathy roadsides and pastures. Common. May, June. Area general.

C. stricta, *Good. Tufted Sedge.*
Native: "Water sides and in marshy places. Not uncommon. April.
At Pophills on the side of a ditch near to the River Arrow," *Purt.*, iii, 556. "38, Warwick, Kirk. Cat," *Top. Bot.*, 440.
I have not seen this plant in any Warwickshire locality.

C. acuta, *Linn. Slender-spiked Sedge.*
Native: Near rivers, canals, and pools. Very local. June, July.
I. Banks of the Blythe, Bradnock's Marsh; near Righton End; Barston Marsh; Temple Balsall; Blythe Bridge, near Solihull.
II. Blacklands, near to Oversley Bridge, *Purt.*, ii, 451. Binley, *T. K., Herb. Brit. Mus.* Chesterton, *Y. and B.* Chesterton Mill Pool! *H. B.* River Avon, near Stratford! *H.B.* In a stream near Newbold and near Stanford Hall, *R. S. R.*, 1877; by Swift at Brownsover, by Brandon Wood, *L. Cumming*; canal near Yarningale Common; canal near Rowington.

C. Goodenovii, *Gay.* (*C vulgaris*, Fries.) *Common edge.*
Native: In bogs, marshes, damp pastures, and roadsides. Common. April to June. Area general.

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There appear to be more than one distinct variety of this common species, which I think deserve closer study than I have yet given to them.

C. glauca, *Scop. Glaucous Heath Sedge.*
Native: In dry heathy pastures, on heathy roadsides, and in quarries. Common. April to July. Area general.
b. Micheliana, Sm. Rare.
II. Wyken Colliery. "Teste Borrer." *T. K., Herb. Perry.* Wyken Rumps. *T. K.,* 1855, *Herb. Brit. Mus.*
C. glauca is not only widely spread, but also differs remarkably in character, and deserves more attentive study than has been as yet given to it.

C. pilulifera, *Linn. Round-headed Sedge.*
Native: In woods, and on heaths and heathy roadsides. Very local. May, June.
I. Sutton Park; Chelmsley Wood; School Rough, Marston Green; Coleshill Heath; Ballard's Green, near Arley; Earl's Wood, in several places; Forshaw Heath.
II. Yarningale!; Haywoods, *Y. and B.;* spinney, near Rugby, *R. S. R.,* 1880.
A form approaching *C. Leesii,* Ridley, occurs with the type on Coleshill Heath.

C. præcox, *Jacq. Vernal Sedge.*
Native: On heaths, heathy roadsides, and turfy banks. Rather local. April to June.
I. Sutton Park; Middleton Heath; Coleshill Heath; near Chelmsley Wood; Marston Green; near Sheldon; Olton Reservoir; Earl's Wood Reservoir; Forshaw Heath.
II. Kenilworth, frequent, *Y. and B.* Yarningale Common; Shrewley Heath; near Haywoods, &c.

C. pallescens, *Linn. Pale Sedge.*
Native: In woods, damp pastures, and damp roadsides. Locally abundant. May, June.
I. Middleton! *Ray, Cat.,* ed. 1, 144; Honiley! *Y. and B.* New Park Middleton; Hartshill Hayes; Kingsbury Wood; damp pastures near Solihull Railway Station; Wheyporridge Lane, near Solihull; damp pastures near Knowle Railway Station; pastures near Lapworth Church; road sides near Earl's Wood.
II. Oversley Wood,! *Purt.,* ii, 447. Drayton Bushes; pastures near Wroxall; wood near Tile Hill Railway Station; Combe Woods; Prince Thorpe Wood, 1870, very abundant.

C. panicea, *Linn. Pink-leaved Sedge.*
Native: In turfy bogs, on damp heaths and damp roadsides. Rather common. May, June.
I. Coleshill Bog; *Ick. Anal.,* 1837; Sutton Park; Middleton Heath; Trickley Coppice; Hartshill Stone Quarries; Whitacre Heath; Earl's Wood.
II. Beausale Heath, *Y. and B.* Roadsides near Stratford-on-Avon, Chesterton, &c.

C. pendula. *Huds. Great Pendulous Sedge.*
Native: In damp woods and woody places, and in drains. Locally abundant. May, June.
I. Maxtoke; Shustoke; Arley Wood; Hampton-in-Arden; Kingsbury Wood; Bentley Park; Spring Coppice, Hockley.

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II. Oversley Wood! Spernal Park, *Purt.*, ii, 444; Honily, *Y. and B.;* Waverley Wood, near Rugby, *L. Cumming;* Seas Wood, Arbury; Combe Woods; Tile Hill Woods; Baddesley Clinton; Rowington Canal Bank; Kingswood; Bearley Bushes; Aston Cantlow; Henley-in-Arden; Moreton Bagot, &c.

C. sylvatica, *Huds. Pendulous Wood Sedge.*

Native: In damp woods, and in damp pastures. Locally abundant. May, June.

I. Tumble Hole, near Shustoke; Hartshill Hayes; Bentley Park; Kingsbury Wood; Drakenidge, near Hurley; woods at Escole's Green; damp pasture near Solihull Railway Station; Spring Coppice, Hockley; woods near Earl's Wood.

II. Kenilworth, *Y. and B.;* Honington, *Newb.;* Alveston Pastures; Oversley Wood; Drayton Bushes; Aston Cantlow; Bearley Bushes; Haywoods; Tile Hill Woods; Combe Woods; Prince Thorpe Wood; Chalcote Wood, Umberslade; Moreton Bagot.

C. lævigata, *Sm. Smooth-stalked Sedge.*

Native: In shady wet places. Rare. June, July.

I. Sutton Park.

II. Harbury Railway cutting; Fosse Road, near Harbury; Sitch Fields, Chesterton, *H. B.;* spinney, near Rugby, *R. S. R.*, 1880.

C. binervis, *Sm. Green-ribbed Sedge.*

Native: On damp heaths, heathy roadsides, damp woods and pastures. Locally common. June, July.

I. Sutton Park; Middleton Heath; Coleshill Heath; Bannersley Rough; Little Hell, near Honily; Forshaw Heath, Tanworth.

II. Oversley Wood; Drayton Rough Moors; Alveston Pastures; Haywoods; Combe Woods.

Not recorded by Purton. Possibly his *C. distans* is referable to this species.

C. distans, *Linn. Distant-spiked Sedge.*

Native: In turfy, brackish bogs. Rare. June, July.

II. Oversley; Coughton, *Purt.*, ii, 445. Near Harborough-Magna, *Rev. A. Blox.* Itchington! Chesterton! *Y. and B.* Southam Holt, *H.B.!* Inland form about Honington; Tredington; a plant of the district in suitable places, *Newb.* Itchington Holt; marshy places in Alveston Pastures; boggy land near the Avon. Binton Bridges.

C. fulva, *Good. Tawny Sedge.*

Native: In shady, turfy bogs, and marshy places. Very rare. June.

I. Sutton Park; abundant in 1875, but now almost exterminated by the railway workings and drainage.

II. Near Stivichall, *T. Kirk.*

C. flava, *Linn. Yellow Sedge.*

Native: In bogs and marshes. Very local. May, June.

I. North end of Sutton Park; Bannersley Pool; marshy coppice, Hill Bickenhill; roadsides near Earl's Wood.

II. Snitterfield Bushes; Oversley, *Purt.*, ii, 445; Hill Wootton, *H. B.;* Milverton, *Y. and B.;* Rowington.

b. lepidocarpa, Tausch. Local, often occurring with the type.

I. Sutton Park, very abundant; Middleton Heath, Baxterley Common; Ballard's Green; Bannersley Pool; marshy coppice, Hill Bickenhill; Coleshill Pool; Marston Green; sand quarry, Cornel's End; damp pasture, Olton Pool; Shirley Heath; Earl's Wood Reservoir; Forshaw Heath.

II. Haywoods; Kenilworth Heath; Yarningale Common, *B. H.;* Chalcot Wood, Umberslade.

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Both these varieties have been compared with specimens received from the late H. C. Watson with which they agree truly, but the var. *lepidocarpa* of all the districts recorded by myself would be included under *C. flava* var. *minor* (Townsend, Journ. Bot., x, 163, June, 1881).

C. hirta, *Linn. Hammer Sedge.*

Native: In meadows and damp places, Locally abundant. May to July.

I. Stew at Edgbaston, *With.*, ed. 7; Sutton Park; Middleton Heath; roadsides near Coleshill; Cornel's End; Bradnock's Marsh; Henfield; Knowle; Solihull; Packwood.

II. Honily, *H. B.;* Honington; Tredington, *Newb.;* Alveston Heath; Binton Bridges; Drayton Bushes; Chesterton Mill Pool; Sowe Waste Canal; Brinklow; Brandon; canal near Newbold-on-Avon; Combe Pastures; Ansty, near Coventry, &c.

(To be continued.)

Reviews.

A Short Hand-book of Natural History. CHESTER. 1884.

THIS pamphlet, which is published by the Chester Society of Natural Science, for use at the Annual Conversaziones and other meetings of the Society, contains a very good but brief account of the two biological kingdoms, a few words at the end being devoted to the mineral kingdom, the polariscope, and the spectroscope. It seems to be founded upon that published in 1882 by the Birmingham Natural History and Microscopical Society, but has been greatly enlarged and improved.

The authors state that they have adopted the classification which they deemed most likely to be known. But that with which they begin the Vegetable Kingdom (p. 4) viz., the arangement of the Fungi and Algæ in two parallel series (due to Sachs), while it scarcely seems to fulfil the condition which they impose, has lately suffered a curious fate. The philosophers of that happy land across the Rhine, who so obligingly furnish us with new classifications *ad infinitum* at frequent intervals, have now thrown it overboard again, even its author concurring in its rejection. It is at present a high crime and misdemeanour in the centres of English biological (at any rate, botanical) teaching, to venture to differ from the latest German authorities on any point, the only difficulty being to make oneself quite sure which is the latest. This classification of the two allied groups will therefore now probably disappear from our books—a fate much to be regretted, because it has a good deal to recommend it, although one class, the "Carposporeæ," is about the most heterogeneous group of forms that the perverted ingenuity of a systematist ever within recent times brought together.

It is much to be wished that our writers would give up the mistaken application of the name Torula (p. 4) to the common yeast and various yeast-like forms. Torula is in the eyes of the mycologist a well-marked genus belonging to a widely different group. The

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Myxomycetes (p. 6) are not now included among the Zygosporeæ, it being at last recognised by our German friends that the "analogy" of the plasmodium to a zygospore existed only in a distorted imagination. The ungrammatical "and which" on the same page (line 19) makes the sentence bear a meaning that is not intended. It is nearly time, moreover, that British cryptogamists learned to call the formation of new plants by ordinary vegetative growth by the name of "multiplication," confining the term "reproduction" to the cases in which some act of sexual union actually or presumably takes place. The English student who reads that the spores formed within the sporangium of Mucor are called "conidia" (p. 6) will probably stare with surprise, although in so naming them the authors are in accordance with the very latest German dictum. The genus *Micrasterium* (p. 5) would be a new one to most collectors of Desmids. Again, the statement (p. 9) that the "Rust of wheat, *Æcidium berberidis*," is "also known as *Puccinia graminis*," is very misleading; it is easy to present the facts in a way which will convey to a layman the meaning intended, but certainly not expressed.

The Equisetineæ (p. 12), which ought to be placed after the Filicineæ, possess, equally with the other Vascular Cryptogams, both isosporous and heterosporous forms, the latter being represented by the fossil Annulariæ and possibly by Asterophyllites. Despite a few errors of this kind the book is a useful and readable one, the chief distinctions between the various classes and subdivisions of animals and plants being described with remarkable clearness, and the examples of each, taken from the Chester district itself, being numerous and well chosen. W. B. G.

The British Moss Flora. By R. Braithwaite, M.D., F.L.S., &c. Part VIII. Fam. VIII. Tortulaceæ I. Small 4to.; 6s. The Author, 303, Clapham Road, S.W.

However bryologists may differ in their views of classification and nomenclature from the author of this elegant work, I am convinced that all will agree in ascribing to him the highest praise for his power as a delineator and for his clearness as a descriptive botanist. The present part contains six plates, with illustrations of forty-two species, and the text embraces descriptions of the various species belonging to the genera *Ephemerum*, *Acaulon*, *Phascum*, *Pottia*, and part of *Tortula*. Both the illustrations and descriptions are excellent, and make one wish that so valuable a work could make more rapid progress. With regard to the classification the author remarks, "This widely distributed family, so rich in species—for it includes probably not less than 800—is a most difficult one to deal with, and has taxed the ingenuity of every bryologist to arrange the species in well-defined genera. The variations in habit, colour, and leaf structure afford more stable ground for generic characters than the peristome, and this was first advocated by Mr. Mitten in his *Musci Indiæ Or.* (1859); but there has been an indisposition to break up the great genus

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Tortula resting solely on the twisted peristome, but combined with a variable structure of leaves; and still stronger was the objection to admit gymnostomous species as congeners with the peristomate ones, although no mosses more clearly exhibit the weakness of this distinction than some of the old *Gymnostomums* now referred to *Pottia*, and the genus *Anacalypta*. Lindberg, in his *Musci Scandinaviæ*, has fully carried out the modern views, and I can only advise all bryologists to study the plants themselves under this newer aspect, feeling assured that they will soon appreciate the soundness of a natural classification." (Page 181.) With these remarks I fully agree, and am convinced that the only natural arrangement that is likely to be lasting must be one in which the cell structure of the leaves takes a prominent part. How far the nomenclature adopted by the author will be accepted by British bryologists it is impossible to predict, but a careful study of the long lists of synonyms will show that the author's desire to do justice to the original authorities has been strictly followed out throughout the work. Part IX., which will conclude the Family VIII., Tortulaceæ, and also complete Vol. I. of this work, is promised for the early part of next year. J. E. BAGNALL.

The Fungi of Norfolk. By CHARLES B. PLOWRIGHT, M.R.C.S. Demy 8vo., pp. 21, 1884.

THE investigation of the Fungus Flora of Norfolk appears to have been first commenced by the Rev. G. Munford, who, in 1864, published a list of seventy-two species found in the county. This botanist was afterwards followed by the present author, and so ably that in 1872 he was able to communicate to the Norfolk and Norwich Naturalists' Society a list of nearly eight hundred species. To this, during the twelve years that have since elapsed, eight hundred more species have been added, so that the present list comprises nearly sixteen hundred species. This is one of the most comprehensive county lists of Fungi that has as yet been published, and does great credit to the industry and scientific ability of the author.

In addition to the list of Fungi there is a "Note on the Classification of the Sphæriaceæ," in which the system adopted by Prof. Saccardo is ably expounded.

The assistance is acknowledged of Canon Du Port, Mr. Frank Norgate, and Mr. J. Harvey Bloome. J. E. BAGNALL.

Norfolk Broads and Rivers. By G. C. DAVIES. Second edition. 8vo., 328 pp., 7 plates. W. Blackwood and Sons.

MR. DAVIES'S book contains the best description of the water-ways of East Anglia with which we are acquainted. While he appeals specially to the sympathies of the yachtsman and the angler, there is much—very much—of deep interest to the naturalist. The account of the decoys—to which three plates are also devoted—is valuable, because it appears that owing to the improved drainage this interesting method

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of catching wild-fowl will before long have passed out of use. The accounts of holidays spent on the Broads in summer, in a little centre-board yacht, are very tempting, and will, we fancy, lead many to follow the author's example. W. J. H.

Phillips's Manual of Geology. Vol. I. Physical Geology and Palæontology. By H. G. Seeley, F.R.S. 8vo., 546pp., 147 woodcuts and coloured plate. Price 18s. C. Griffin and Co.

The last edition of Prof. Phillips's valuable work was published in 1855, and the progress of science since that date has been so great that the book, the title of which appears at the head of this notice, is practically a new work. It is a work on which Prof. Seeley has expended great labour, and from a careful study of its contents we can say that it will prove a most valuable book of reference for students of geology—British geology especially. The introductory chapters deal with the origin of geology and the earth; minerals have one chapter allotted to them, while rocks require four. Volcanic rocks—ancient and modern—are treated of in great detail, while the chapters on "Coast Lines and their Origin," and on the "Relation of Scenery to Geological Phenomena," are of great interest for even the general reader. Two chapters are devoted to an introduction to Palæontology. Those who know the valuable work which Prof. Seeley has done at Cambridge and in London, together with the ripeness and catholicity of his knowledge, will be pleased to possess this book, which contains much that is both new and true, while the old truths on which the science of geology rests are set forth with simplicity and accuracy. The illustrations are well conceived and telling. W. J. H.

THE MICRO-VEGETATION OF BANK NOTES.*

The recent researches of Paul Reinsch in Erlangen have revealed the occurrence, on the surfaces of the coins of many nations, of different bacteria and two minute algæ (Chroöcoccus monetarum and Pleurococcus monetarum, P. Reinsch), living in a thin incrustation of organic detritus composed especially of starch-grains, fibres, &c., deposited upon their surfaces during the course of long circulation. This thin incrustation renders the coins very suitable for this micro-vegetation, but the same phenomenon is exhibited by paper money, and, indeed, by notes of clean and, to the naked eye, unaltered surface.

I have scraped off some of these minute incrustations with hollowed scalpels and needles, and divided them into fragments in distilled water that had been boiled shortly before, and, upon examining them with lenses of high power (R. T. Beck's 1-10th inch), have seen the various Schizomycetes distinctly.

* *The Micro-vegetation of Bank Notes.* By Dr. Jules Schnarschmidt, Privatdocent of Cryptogamic Botany and Anatomy of Plants, Assistant of the Botanic Institutes and Royal Gardens, Hungarian University, Kolosvár.

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I can now proceed to give a brief account of the results I have obtained from the investigation of the paper money. I have investigated the Hungarian bank and State notes, recent and old (from the years 1848-49), also Russian rouble notes, and have found bacteria upon all of them, even upon the cleanest.

On the surface of all the paper money is always to be found the special bacterium of putrefaction, viz., Bacterium Termo, Dujardin.

In the thin incrustations on the paper money I ascertained the occurrence of starch-grains (especially those of wheat), linen and cotton fibres and animal hairs, and, in this deposit upon the florin State notes, the Blastomycete, Saccharomyces cerevisiæ, in full vegetation.

Various Micrococci, Leptotriches (many with club-shaped, swollen ends), and Bacilli are also the most frequent plants in the deposit on the paper money.

The two new species of algæ described by Paul Reinsch are very rare on paper money. The green pleurococcus cells have been observed in some cases on 1 and 5 florin State notes, and the bluish-green minute Chroöcoccus on the border of the 5-florin State notes.

The vegetation of the paper money is, according to my researches, composed of the following minute plants:—

1. Micrococcus (various forms); 2. Bacterium Termo; 3. Bacillus (various forms); 4. Leptothrix (species?); 5. Saccharomyces cerevisiæ; 6. Chroöcoccus monetarum; 7. Pleurococcus monetarum. From a hygienic point of view, an investigation of the commonest household objects, and especially of books, &c., used by students may not be superfluous.—*A. K., Klausenburg, Hungary, in "Bulletin of the Torrey Botanical Club."*

METEOROLOGICAL NOTES.—November, 1884.

Barometric pressure was very unsteady throughout the month, and consisted of a series of fluctuations between 29·6 inches and 30·5 inches. The mean was, however, above the average. Temperature was about the average. The range was greatest at the commencement of the month, least in the middle. On the 14th the range did not amount to 3 degrees. The highest maxima observed were 59°0 at Coston Rectory, on the 2nd; 58°6 at Hodsock, on the 1st; 58°2 at Loughborough, on the 2nd; 57°1 at Strelley, on the 1st; and 57°0 at Henley-in-Arden, on the 5th and 7th; 101°2 was recorded at Hodsock in the rays of the sun, and 98°5 at Loughborough, on the 9th. The lowest minima occurred on the 30th, and were 20°0 at Coston Rectory; 21°0 at Henley-in-Arden; 21°8 at Hodsock; 22°1 at Loughborough; and 23°3 at Strelley. On the same date, the thermometer exposed on the grass, registered 17°9 at Loughborough; 18°1 at Strelley; and 19°5 at Hodsock. The rainfall was again decidedly below the average, especially in the East Midlands, where the amount in no case reached 1½ inches. At Henley-in-Arden the total value was 2·20 inches. Snow fell on the 30th. The prevailing winds were westerly, and generally light in force. Sunshine was deficient. Much inconvenience has been occasioned in several districts through the scarcity of water.

Wm. Berridge, F. R. Met. Soc.

12, Victoria Street, Loughborough.

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Natural History Notes.

A Fungus Foray.—If Mr. Bagnall will refer to former volumes of the "Midland Naturalist" he will find *Ag. ditopus* recorded in the volume for 1883, pp. 264, 272, and *Ag. furfuraceus* in the volume for 1882, p. 184.—W. B. G.

Anker Flora.—About the middle of last month (November), in company with Mr. E. De Hamel, of Tamworth, I had a short botanical walk over Warwickshire Moors, Rye Hills or Royals, by Rimington Hall, and so back to Tamworth. Much of the ground we went over is moorish pasture land, drained by the River Anker, and numerous tributary streams. The season was too late for me to form a true estimate of the floral riches of the district, but from what I was able to identify I should think the flora of this river basin would be found to be both rich and varied if the ground were well worked earlier in the season. During our walk I took notes of all that could be still recognised, and found when I reached home that we had observed over 126 species, representing 88 genera and 38 natural orders of flowering plants, and several very local mosses. Among the plants recorded two are new as records for the Tame basin, viz.: *Œnanthe fluviatilis* and *Potamogeton densus*, and the following are species that I consider noteworthy:—Ranunculus circinnatus, R. fluitans, Callitriche obtusangula, C. hamulata, Helosciadium inundatum, *Œnanthe fluviatilis*, Tanacetum vulgare, Veronica polita, V. Anagallis, Lemna gibba, L. trisulca, Acorus calamus, Potamogeton serratus, *P. densus*, Zannichellia palustris, Sagittaria sagittifolia, Butomus umbellatus, Agrostis nigra, Phragmites communis, Glyceria aquatica, Chara fragilis. The more noteworthy mosses are:—Tortula latifolia, Fontinalis antipyretica, Leskea polycarpa, Scleropodium cæspitosum.—J. E. Bagnall.

Only a dead Spider.—I fancy I hear many say—"Well, what is there extraordinary in a dead spider; throw it away, the nasty horrid thing; I hate all spiders." But I am glad to say that this particular dead spider, and the lesson learned from it, has not been thrown away upon one human being at any rate, and I write these few lines hoping that others may have their hearts touched and rebuked. A short time ago I had occasion to visit a grocer's shop, when one of the assistants (knowing my love for all creeping things) said—"Oh, Mr. ——, we have got a great big dead spider for you which we found some time ago at the bottom of a tea chest which had just been emptied." On examining the specimen, I found it to measure over four inches across its legs, the head or cephalo-thorax being half an inch long, the abdomen shrivelled up, but grasped tightly within its jaws was a large round and flat cocoon of eggs, one inch diameter. This latter fact at once gave me an idea as to what family it belonged, viz., the Lycosidæ, of which we have in Great Britain between thirty or forty representatives, all of which are in the habit of carrying about with them their cocoon of eggs, grasping it firmly with their powerful jaws, besides having a silken cord attached to it from their spinners. On a warm, sunny day in June I have often seen thirty or forty specimens of *Lycosa agretica*, males and females, basking in the sun on an old box, tin pot, or broken piece of pottery lying about near a hedge, at the approach of anyone running and hiding away underneath stones and among the dry herbage at the bottom of the hedge, waiting until all danger is past. But if the intruder on their peace attempts their capture, they do, indeed, run for their lives, dodging in and

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out, taking advantage of every nook and cranny wherein they can hide, so as to avoid detection, and just as the entomologist makes a pounce upon one, it makes another effort to escape capture by running through the rank grass, when suddenly it stops in its rapid retreat, and actually turns back! as if in seach for something, apparently having lost all desire to escape, moving slowly and carefully, when all at once it starts off again as if filled with new life, and as often as not succeeds in reaching a place of safety at the bottom of a thorny hedge. What is the cause of all these strange changes in its behaviour? The poor spider has not been running to save its own life only, but for the safety of its precious cocoon of eggs, and its sudden stop was caused by having its load rudely jerked from its grasp as it was running through the coarse grass, and then it was that it seemed to care so little for its own safety, but as soon as it had regained its treasure, then all its energy was renewed, and nothing would induce the spider to part with its cocoon. Such is a rough sketch of one of our indigenous spiders, to which family this big dead one belonged; it had, no doubt, been basking on the sides of an empty tea chest, when a "Heathen Chinee" came along and emptied his load in, smothering the poor spider, which might have effected its escape had it not been encumbered by its load of eggs, no mean hindrance to its free movement when buried in the tea; but rather than loose its hold and escape, it, like the standard bearer, held on with the grasp of death. Surely we mortals can learn something from the affection displayed by this spider, and perhaps the heart of some brother naturalists may be touched in a practical manner at this time of year, when there are thousands of poor little half-starved waifs and strays who have never had the parental affection shown to them such as "only a dead spider" showed to its offspring as long as life lasted, and, "being dead, yet speaketh."—A Lover of Spiders.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—General Meeting, December 2nd.—Mr. W. B. Grove, B.A., read a paper on "New or Noteworthy Fungi," part 2, which was illustrated by numerous and beautifully-executed microscopical drawings. He described several species new to science, and a large number new to Great Britain, and nearly all collected in this district. Biological Section, December 9th.—Mr. W. P. Marshall in the chair. Mr. T. Bolton exhibited *Nais hamata*, a worm described as a new species last year by Professor Tims, of Wurzburg. Also the larva of the Fairy Shrimp, *Cheirocephalus diaphanus*, and mounted specimen of a very rare entomostracan, *Lynceus acanthoceroides*, both from near Bewdley. Mr. W. H. Wilkinson: Lichens, *Physcia parietina*, *Peltigera horizontalis*, *P. rufescens*, *Evernia furfuracea*, *Ramalina fastigiata*, *Usnea barbata*, *Alectoria jubata*, *Lecanora atra*, and other lichens from Scotland. Also the Kilmarnock Willow, a pendulous variety of the common Goat Willow, *Salix caprea*, from the banks of the River Ayr, in Scotland. Professor Haycraft, M.B., then read his paper on "Some New Observations upon the Physiology of the Medicinal Leech," *Hirudo medicinalis*, illustrated by a large diagram, black board illustrations, and a series of specimens under the microscopes. Professor Haycraft described some experiments performed by him in the Physiological Laboratory of Mason College. He had found that the

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medicinal leech secretes from its sucker and gullet a juice which has the peculiar property of preventing the coagulation of blood. This juice can be extracted with water, and if the extract be added to blood, freshly drawn, this remains permanently fluid, instead of clotting in the usual way. The coagulation of blood is due to the formation of a substance called fibrin, by the action of a specific ferment. This latter is destroyed by the leech extract. On invertebrate blood, when the clotting is due to another cause, the secretion has no action. From experiments which he had recently performed in Germany, the Professor found that an extract of three or four leeches, injected into veins of a living dog or rabbit, produced well marked fluidity of the blood, and other symptoms more interesting to the physician than to the naturalist. In the leech's own economy the juice plays an important part. As is well known, the blood "sets" in a solid mass around the edges of an ordinary wound—say that produced by a razor cut. This stops the continuous bleeding which would otherwise follow. Now but for this juice, which flows from the sucker into the wound when the leech bites, the creature would suck in vain. After the first few drops had exuded no more would flow, and that which had passed into its gullet would set into an indigestible clot. One can now explain why, when the leech is removed, the wound continues to bleed often for a very long time; its edges are impregnated with the juice, and clotting only occurs when this has been all washed away.—A discussion followed, in which the Chairman, and Messrs. W. R. Hughes, R. W. Chase, T. Clarke, France, Cullis, and others took part. Professor Haycraft also presented to the Library of the Society a copy of his paper as read before the Royal Society. MICROSCOPICAL GENERAL MEETING, December 16th.—Mr. C. Pumphrey exhibited, by the aid of the lantern, a series of photographs taken by him during his journey and visit to Canada and America. The first was a view of the Liverpool Docks, then several pictures taken on board the steamship "Vancouver" during the voyage to Quebec, such as groups of passengers, some in repose, others occupied in games to pass away the time; then waves and icebergs. On arriving at Quebec Mr. Pumphrey did not go on to the meeting of the British Association, but made his way to the Yellowstone Park, a large tract of land about sixty miles square, set apart by the Americans as a park for ever; it is reached by a southern branch on the North Pacific Railway. He also exhibited several views taken on the way, such as an Indian town with its wigwams, the city of Winnipeg, interior of a Pulman car, and interior of a dining saloon in a steamboat on Lake Superior. Arriving at the Park there was the Mammoth Hotel, containing a thousand beds, and another hotel, which was composed of canvas tents only. Views were given of the hot springs, showing the peculiar shapes assumed by the tufa, formed by the lime from the hot water; also views of the geysers, showing how they deposited siliceous matter; but the grandest views were those taken of the great cañon, or ravine, which is about one thousand feet deep, and at the top one mile wide. Through this the Yellowstone River runs, and in one part it falls three hundred and fifty feet. Here the scenery is grand, and Mr. Pumphrey has obtained several good pictures. The exhibition was very interesting and instructive, and as only half the pictures were shown the members will have an opportunity of seeing the others on some future occasion.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—November 17th.—Mr. Madison exhibited various specimens

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of foreign Helices. Under the microscope the following objects were shown: by Mr. Moore, antennæ of *Volucella plumata;* Mr. Darley, larva of *Ephemera marginata;* Mr. Tylar, an electro-deposit of Silicon resembling a chain diatom; Mr. J. W. Neville, a palate of *Fusus Islandicus*. Mr. Betteridge then contributed his third paper on the "Birds of the District." November 24th.—A Lecture was delivered by the President, Mr. C. Beale, C.E., on "What is under us," in which he described the surface beds from the place of meeting, through Deep-fields, to Sedgley Beacon; from this point the Lecturer dealt with "What is under us." The Silurian rocks were described in their descending order: the arrangement of the beds of the upper, middle, and lower Ludlow and Wenlock formations, the circumstances under which they were deposited and the forms of life most prevalent and peculiar to each. The formations of Cambrian age were next described as rocks in which the traces of life could still be made out, and the Laurentian, of which only an inconsiderable portion was found in this country. In the Pre-Cambrian rocks the records of life were nearly obliterated, and the few found only of the lowest kind. The lecture concluded by assigning reasons for the great antiquity of the earth—an antiquity altogether beyond human comprehension, and pointing out that, notwithstanding the diligent researches made in geology, we are as yet only on the border-land of knowledge. The lecture was illustrated by a beautifully drawn section of the earth's crust and some of the rarer rocks and fossils. December 1st.—Mr. Hawkes exhibited the following fungi: *Lecythea euphorbiæ*, *Coleosporium senecionis*, *Puccinia variabilis*, *Puccinia lychnidearum*, and *Puccinia sonchi*, the latter pronounced by Mr. W. B. Grove a species new to Great Britain. Mr. Hawkes also showed the paraphyses of this fungus under the microscope. Mr. Rodgers then read a paper on "Other Worlds than this," in which he described the sun and its analysis by the spectrum, the solar system, three stages in the life of a world—youth, maturity, and old age, and the arrangement of the planets in their stages of development judged by telescopic appearances. The paper also described stellar worlds, and their great distance adding to the difficulty of observation, the motion of the solar system in space, its direction, &c. The paper was illustrated by diagrams. December 8th.—Mr. Moore exhibited a large specimen of *Unio pictorum* from Ossington Lake; Mr. Rodgers, a collection of shells from Lamlash Bay. Under the microscope, Mr. Dunn showed a specimen of *Hydra vulgaris* with a branched tentacle (probably the result of an injury); Mr. Tylar, marine organisms, larval stage of starfish, echini, etc.; Mr. Sanderson, *Riccia fluitans*. December 15th.—Special: Geology. Mr. Insley showed fossils from Wenlock limestone, including *Calymene Blumenbachii*, and quartz crystals from various localities; Mr. Hawkes, specimens of asbestos and some of its manufactured products; Mr. J. W. Neville, fossil calamites, and a transverse section of the same under the microscope; Mr. Moore, section of fossil coral, *Cyathophyllum articulatum*. Among other exhibits Mr. Madison showed a singular shell of *Helix aspersa*, having two complete lips; Mr. Hawkes, pods of cotton plant, and ornamental articles from India made of native seeds; Mr. Deakin, jaw of porpoise, *Phocæna communis*.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY.—Section D, Zoology and Botany.—Chairman, F. T. Mott, F.R.G.S.—Monthly Meeting, December 17th. Attendance 10 (3 ladies). Exhibits: The rather uncommon lichen *Collema pulposum* (?) by Mr.

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F. Bates, who had prepared a microscopic slide showing the moniliform character of the gonidial layer. These moniliform curved filaments were, he considered, quite undistinguishable from *Nostoc*, a fact which favoured the theory of Schwendeer that lichens consist of a fungus parasitical on an alga; a collection of dried leaves of various species of American oaks, by Mr. Vice; oak spangle-galls, and the fungus *Agaricus confluens*, by Mr. Grundy; large haws borne by the scarlet-fruited thorn, and a camera drawing of the large mole flea × 40, by Mr. Mott. Paper, "On the life-history of *Puccinia graminis*, the Wheat-Rust fungus," by Mr. G. Ward, describing its three stages, viz.:—the Æcidium stage on the leaves of the Barberry, formerly ranked as a distinct species under the name of *Æcidium berberidis*; the Uredo stage on wheat and other grasses in the summer, producing globular spores; and the Puccinia stage on the same plants in the autumn, producing the final, resting, or teleuto-spores, which are clavate and uniseptate. Mr. Ward had prepared several interesting slides, which were exhibited under the Society's fine binocular microscope, illustrating the stages of this remarkable fungus. The Chairman asked how it happened that while Rust was everywhere abundant, the wild Barberry was quite a rare plant in Leicestershire hedges. He thought there must be some other plant on which the Rust could pass through its first stage. The Chairman presented a list of 15 birds which frequented his garden, arranged in the order of their abundance, viz.:—1, House Sparrow; 2, Starling; 3, Missel Thrush, Song Thrush, Blackbird; 4, Robin; 5, Hedge Sparrow, Chaffinch, Blue-tit, Wren; 6, Great-tit, Pied Wag-tail; 7, Yellowhammer, Spotted Flycatcher, Greenfinch. He remarked upon the scarcity of the Yellowhammer in his neighbourhood, and suggested that it might lead to interesting comparisons, if other members living in the different suburbs would prepare lists of birds arranged on the same principle.

PETERBOROUGH NATURAL HISTORY, SCIENTIFIC AND ARCHÆOLOGICAL SOCIETY.—At a well-attended meeting of the members of this Society, held on November 28th, Mr. James T. Irvine, clerk of the Restoration Works at the Cathedral, gave a very interesting address on "Saxon Architecture," illustrated by numerous drawings collected or made by himself. After pointing out the imitation of wooden construction this style presented in buildings actually of stone, the lecturer dealt with its other chief characteristics—the great internal height of the buildings when considered in regard to their length and breadth, the extreme thinness of the walls, the great height and narrowness of the openings, such openings in the earlier examples being wider at the base than at the top, whilst in the later ones the sides were parallel—the wedge-shaped quoin stones—the rude imitation of Roman mouldings—the gradual adoption toward the close of the Saxon period of features closely approaching Norman work. Mr. Irvine also called attention to the position of the window sashes, the earlier ones being fixed in the mid-wall, and later ones near the outside and provided with shutters; the ornamental character of the window jambs as at Boarhunt near Portsmouth, and in some remains found at Peterborough Cathedral; the use of coloured stone decoration as at Stone-juxta-Faversham; the singularly fine carvings found at Bradford in Wilts, date probably about A.D. 975, and at Barnack Church, near Stamford, the date of which the lecturer considered to be about A.D. 1060. Mr. Irvine also referred to the singular fancy for sundials, of which a beautifully carved specimen exists at Barnack.

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FLOSCULARIA MUTABILIS.

This very curious Floscule was discovered by Mr. Bolton in Olton Reservoir, near Birmingham, on August 7th, 1884, and he has since found it in several other pools in the neighbourhood. It is remarkable for having a disc with only two lobes; for possessing what appear to be two eyes on the dorsal lobe, near its summit; and for its habit of altering the shape of its disc till it somewhat resembles that of an Œcistes or Limnias, and then of swimming by vibrating the short setæ that surround the edge of the disc. There is another two-lobed Floscule, discovered by Mr. Hood, of Dundee, an account of which I shall shortly publish. I have named it *F. calva* from its remarkably short setæ. It does not, however, swim like *F. mutabilis*, nor does it possess red eyes. Oddly enough, however, it also is attached to its tube, and not to the stem of the alga on which the tube rests, so that it almost always tumbles off its perch when sent by post.

F. mutabilis generally swims backwards, circling very slowly, and sure to be soon pulled up by some obstacle. Now and then it has a fit of energetic straight swimming, but even then it is usually stem foremost. It frequently shuts up its lobes like a puckered bag; and I have seen it often protrude the real mouth (which, as in all Floscules, lies deep down at the bottom of the "vestibule") right beyond the outer edge of the lobes.

The young female (Fig. 3) is somewhat similar in shape to the adult, but has the swelling of the foot more marked.

I have seen three specimens of what I believe to be the male (Fig. 4), but from my not having seen it hatched I cannot be certain. The figure shows its external shape—it was on each occasion too lately hatched to detect the sperm bag and penis: it had no teeth or alimentary tract.

I may add that Mr. W. Dingwall, of Dundee, has sent me two or three specimens of a one-lobed (or rather lobeless) Floscule, an account of which will soon appear. There is now a regular series of Floscules with 7, 5, 3, 2, and 0 lobes.

C. T. Hudson, LL.D., F.R.M.S.

15th September, 1884.

PLATE I.

Description of the Figures.

Fig. 1. Floscularia mutabilis (side view) at rest $\frac{1}{80}$ inch.
" 2. " " " swimming $\frac{1}{80}$ "
" 3. " " young female $\frac{1}{180}$ "
" 4. " " supposed male $\frac{1}{180}$ "

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ON "THE BEST METHODS OF STUDYING BOTANY FOR BEGINNERS."*

BY F. T. MOTT, F.R.G.S.

Persons who begin to "study Botany" do not generally realise the vastness of the subject. Botany is the history of the whole Vegetable Kingdom, and the Vegetable Kingdom occupies much more space on the surface of this globe than the Animal Kingdom does, and has probably a much larger number both of individuals and species.

Such a subject can only be attacked piecemeal. We must divide it into Sections and study each Section separately, not, however, losing sight of their relations to each other and to the whole.

The history of Vegetables may be conveniently divided into six great Sections, viz.:—

1. The visible structure of a Plant; its parts or organs, as stem, leaf, flower, &c., the various forms of these, and the tissues of which they are built up. This is called Structural Botany.
2. The chemical constituents of these tissues, the chemical processes which go on within them, and the vital functions carried on by the different organs. This is called Physiological Botany.
3. The grouping together of plants of similar form, and the tracing of the blood relationship among these groups. This is Classification or Systematic Botany.
4. The distribution of these groups on the various parts of the earth's surface, on the land, and in the water. This is Geographical Botany.
5. The plants of previous geological periods which are now found fossilized in the rocks, and the correlation of these with existing species. This is Palæontological Botany.
6. The uses of plants to man and animals as food or medicine, or as materials for clothing, building, and various other arts. This is Economic Botany.

* Transactions of Section D of the Leicester Literary and Philosophical Society. Read March 19th, 1884.

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I have arranged these Divisions in a natural sequence, answering the questions—

What is a Plant?

How do Plants differ from one other, and how are they related to each other?

How are they distributed in space and in time? And

What is their value to animals?

But for the purpose of amateur study I should arrange them differently. What beginners find most interesting is the knowledge of plants by sight and by name, and some knowledge also of their economic uses.

We may arrange the sections, therefore, into an Elementary Department and an Advanced Department. The Elementary Department will include Nos. 1, 3, and 6—Structure, Classification, and Economic Use; and the Advanced Department will include Nos. 2, 4, and 5—Physiology, Geography, and Palæontology. As we are concerned at present with beginners only, we may dismiss the Advanced and confine our attention to the Elementary Department. How may an Amateur best set about to obtain some personal acquaintance with plants and their uses?

The plants which come under our notice in this country are in two groups—the wild and the cultivated. Some of our cultivated plants are also found wild, but the majority are importations from other countries and are only to be seen in gardens and hothouses. This does not make them any the less interesting to the Botanist, but for a beginner there is considerable advantage in restricting his early studies to our native wild plants, because these form a comparatively small and yet a fairly representative group, and an acquaintance with these will give him a general view of plant forms and plant life which may be afterwards extended in all directions. Moreover, wild plants of all the principal forms are readily accessible to everyone, while an average garden will only contain a small selection of the more showy forms.

Let a beginner, therefore, begin with the study of the British wild plants.

The first step is to get some knowledge of the structure of plants. In most towns there are, during the winter, courses of lectures by certificated Science teachers, and if Botany is one of the subjects no better introduction can be had than passing through such a course. The course usually consists of from twenty to thirty lectures of an hour each, and the usual fee is 2s. 6d. for artisans who can earn the Government grant for the teacher, and from 10s. to 20s. for all other persons for whose teaching the Government will pay nothing.

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The course begins in the autumn and finishes in the spring, and the student who goes through it conscientiously will gain a fair knowledge of the principles of Elementary Botany.

If no such course is available, there are plenty of good books from which he may get similar information, but it is rather drier and harder work to read for yourself than to follow a teacher. Among the many books on Elementary Botany, of which I have no less than sixteen in my own library, the following three may be particularly recommended, viz.:—

Dr. Hooker's "Primer of Botany," price 1s.

Prof. Oliver's "Lessons in Elementary Botany," price 4s. 6d.

Mrs. Kitchener's "A Year's Botany," price about 6s.

If the student happens to possess any other recent work of the kind it will do nearly as well. If not, let him buy one or all of these and read them through, carefully following their instructions. Nearly every book will contain something not found in the others.

The next step will be to get a personal acquaintance with the wild plants, to learn to know them by sight and by name, to be able to classify them, and to ascertain their uses. Something of all this will have been gathered in going through the books already mentioned, but a good deal more is required. In order to impress upon the memory the appearance and the names of plants they require to be brought *frequently* under notice—once or twice is not sufficient.

For this purpose there is no better method than the forming of an Herbarium or a Botanical Garden, or both. The plants must be collected, the names and classification worked out from books, the specimens frequently handled, and then preserved either dried in an Herbarium or living in a classified garden—the latter is the less common but perhaps the more interesting method; but it is also much more difficult, because some plants are too large and others too small to be easily manageable, while some want water, others rock, or peat, or sea sand, and will not flourish in common garden soil. The dried garden, *hortus siccus*, or Herbarium, is therefore the usual method of preserving the specimens, and it is easy, cheap, and fairly satisfactory. Many of the books give full instructions for drying and mounting the plants, but I may say here that perhaps the best paper for drying is that supplied by West, Newman, and Co., 54, Hatton Garden, London; that a beginner should have at least three quires

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of this paper, and that the plants must be changed into dry papers at least three times—first after twenty-four hours' pressure, then after two or three days more, and again after a week. Or they may be laid in the drying papers in a tin dish just large enough to hold them, dry sand spread on the top an inch thick, and placed on a warm stove or in an oven of moderate heat. They will want careful watching so as not to bake too rapidly, but with proper attention they may be got perfectly dry in one or two days, or even in a few hours, by this method, and will keep their colour better than if dried more slowly. The mounting paper should be about 16½ins. by 10½ins., and the specimens fastened on by strips of gummed paper, using only just as many as will hold all parts firmly to the paper, and cutting them broad enough to give a firm adhesion. They are often used too narrow. Some persons glue the whole specimen to the paper, and in Herbariums subject to continual turning over, as in public museums, this is the safest; but in private collections it is, I think, unnecessary and undesirable, as it takes more time, gives a more unnatural appearance, and prevents the specimen from being changed or in any way moved for examination. The species of each genus should be put together in a sheet of coloured paper, labelled outside, and the packets properly arranged in a cabinet, or in a set of boxes made to stand up like large books on a shelf.

For determining the names and characters of British plants there are several good works. The most costly of these is Sowerby's "English Botany," of which the third edition consists of eleven volumes, with a twelfth now in preparation, price about £20, giving a coloured plate of every species. This is excellent as a help and for additional information, but it is not good to work by, having no synopsis or key of any kind. I should recommend for beginners Bentham's "Illustrated Handbook of the British Flora," in two volumes, with admirable woodcuts of each species. When they have acquired some knowledge of common plants Hooker's "Student's Flora," price 9s., will be better, as although without plates or woodcuts it is very compact, very full and clear, and contains most of the modern seggregates, or distinct varieties of certain species, which are omitted by Bentham for the sake of simplicity. Babington's "Manual" is nearly as good as Hooker and about the same price. Anne Pratt's large work with coloured plates is useful for reference and for popular information about the history and qualities of plants, but is not precise enough in its descriptions nor accurate enough in its plates for the real student. Leo Grindon's

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"British and Garden Botany" contains an immense amount of interesting information, but is not a good working book. When a fair acquaintance with British plants has been obtained, if the student wishes to go further and examine the plants of gardens or of the world, the number of species is so large that no one book has yet attempted to describe them all. Loudon's "Encyclopædia of Plants" gives descriptions of nearly 20,000 species, and woodcuts of 10,000, and is an invaluable work; while Le Maout and Decaisne's "Descriptive and Analytical Botany," edited by Dr. Hooker, gives an excellent account of the 300 orders of known plants arranged according to the most modern system of classification. The price of the first is about two guineas and of the second 30s. If to these the student adds Sachs's "Text-book of Botany," price about 30s., he will have, in addition to the works previously recommended, a Botanical Library sufficient for most amateurs.

ON THE PRE-CARBONIFEROUS FLOOR OF THE MIDLANDS.

BY W. JEROME HARRISON, F.G.S.

The researches of British geologists, continued without intermission since the beginning of the present century, have at last rendered possible the study of the physiography of the Midlands during the geological ages which are past.

The completion of the one-inch geological map of England by the Government Survey during the year 1883 marks an epoch in the history of geology; but, in the case of amateur geologists, it is certain that the publication of these maps, furnishing—as they are supposed to do—a "royal road" to the study of the rocks of any district, has led them to take too many things for granted, and to suppose that finality in things geological has been attained.

In this paper I propose to consider what is known of the Pre-Carboniferous strata—the Archæan, Cambrian, Silurian, and Devonian Formations—of the Midlands; to detail some startling discoveries which have been made within the last two or three years with regard to them, and to point out their bearing upon palæo-physiography and upon certain geological problems of high interest.

Methods of Investigation.—Fortunately for local geologists the rocks of the British Isles have, perhaps, been more crumpled up, broken, eroded, and disturbed than any other

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area of equal dimensions upon the surface of the globe. The axis of greatest elevation now lies to the west, running through the Lake District and Wales. From this it results that the strata have a general dip or slant to the south-east, the oldest rocks forming the actual surface of the ground in these western tracts, but being covered over and concealed by newer rocks as we proceed eastward. If all the beds of rock lay in regular undisturbed sheets, as they must have originally been deposited on the sea bottom, we, in the Midlands, could never hope to discover any Pre-Carboniferous strata at the surface, for they would be below thousands of feet of later-deposited rocks. But, during the upheavals and depressions which the British Isles have experienced —and they have undergone many changes of level, amounting to thousands of feet—the rocks have cracked, and the beds along one side of the crack or "fault" have been elevated or depressed as the case may be. Then lateral pressure, whose effects have but lately been recognised on a grand scale in the Highlands of Scotland, has thrown the rocks into great folds, having crests and hollows. Following these earth movements, the agents of denudation have swept away the material from the "upthrow" sides of the faults, and from the crests of the earth-folds, and thus the wonderful variety of rocks which characterises our country has been produced, and we are able to find strata of the same age and of similar lithological characters to those of Wales and the Lake District within a short distance of Birmingham and Leicester.

But to discover and identify every exposed area of these old rocks in the Midlands our search must be both keen and careful, and we must have a competent knowledge of what to look for, gained by the study of typical sections and specimens. Although the geological surveyors are instructed to walk along the four sides of every field and to examine every patch of rock—and I can bear testimony to their hard and generally excellent method of work—yet they missed the true interpretation of many important exposures, and it is clear that in the present position of British geology more good will result from the close study of a limited area than from occasional scamperings over a wide region. I remember well, many years ago, how I walked over all Leicestershire to find an outcrop of the Rhaetic beds, which I discovered at last in a brick pit close to my own back door!

We will consider, in the first place, those Midland areas in which the old Pre-Carboniferous strata actually rise to the surface; secondly, the places where they have been

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reached by mines or deep bore holes; and lastly, the probable manner in which they extend underground between the points where their presence has been actually determined. Only those points will be considered in detail which have not been already published.

Surface Exposures of Pre-Carboniferous Rocks.—The ancient rocks which we have to describe crop out as "islands" or "bosses," along a line from south-west to north-east, extending from the Malvern Hills, by the Wrekin, the Lickey Hills, and the Hartshill Range to Charnwood Forest in Leicestershire.

1.—*The Archæan Rocks of Charnwood.**—Charnwood Forest is a hilly rocky tract of about thirty square miles, lying between the towns of Leicester, Loughborough, and Burton. The rocks consist of coarse slates, grits, and agglomerates, about ten thousand feet in thickness, and of volcanic origin. They strike from north-west to south-east, and are broken through by syenitic and granitic masses, with the result that at one point (Brazil Wood) the slate has been converted into a micaceous schist. The Charnwood axis is continued to the south-east, beneath the Triassic strata of South Leicestershire, being overlaid in that direction by Cambrian rocks presently to be described. The ashy slates of Charnwood are believed to be of Archæan or Pre-Cambrian age, for the following reasons:—(*a*) they agree well, both when studied in the field and when examined microscopically, with the *Pebidian Formation* of Dr. Hicks; (*b*) they have yielded no fossils of any kind; (*c*) they are certainly overlaid by Cambrian strata, although the junction is concealed from view by newer beds.

(To be continued.)

THE PRINCIPLES OF BIOLOGY.

BY HERBERT SPENCER.

EXPOSITION OF CHAPTER VII.—GENESIS.

BY W. B. GROVE, B.A.

Genesis is the multiplication of individuals. In the cases most familiar to us this takes place in such a way that like produces like, the offspring closely resembles the parent. But modern science shows us that this is not the most

* See "Geology of Leicestershire," by W. J. Harrison; and Hill and Bonney, Quart. Jour. Geol. Soc.

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common form of genesis; in the great majority of plants and in numerous animals like produces unlike, the offspring does not resemble the parent. This is the exact reverse of the opinion which the ancients held and the unscientific of the present day would express, but it is nevertheless the correct one, and the scope of its application every year grows wider. These two modes of multiplication are designated respectively by the apt names of *homogenesis* when the successive generations are alike, and *heterogenesis* when they are diverse.

But we may look at the matter from another point of view—the production of a new individual may result from the fusion of the whole or a portion of each of *two* more or less distinct previously existing individuals, *i.e.*, from a sexual act; or it may originate merely by the separation of a part of *one* individual in such a form as to be capable of independent growth. These two modes are called by the delightfully expressive names of *gamogenesis* and *agamogenesis* respectively.

Herbert Spencer then lays down the following laws:—(1) Homogenesis is always gamogenesis; (2) Heterogenesis is agamogenesis interrupted more or less frequently by gamogenesis. These statements we will now examine.

The kind of homogenesis with which we are most familiar is that met with in the larger animals, where each generation consists of males and females; it occurs under three forms, as viviparous, oviparous, and the intermediate ovoviviparous genesis. As we descend in the animal kingdom we find homogenesis become rarer and rarer, and at last entirely replaced by the other mode. Amongst plants, as will be seen hereafter, homogenesis, strictly speaking, never occurs.

When heterogenesis prevails we shall find that after a generation of perfect males and females there will be a generation of asexual individuals, which produce the next generation by a process of budding. This next generation may consist of males and females like those with which we started, or may be itself also asexual, and produce another generation by budding; but sooner or later the sexual generation will again occur and complete the cycle. Illustrations of both these modes are most readily seen in plants. Take a simple uniaxial plant, originating from a seed, and having a terminal flower. The stem and leaf appendages of this constitute a single individual, which is itself sexless, and produces buds, each bud being a new individual. From certain of these buds, which are male, pollen-grains are formed; from certain others, which are female, ovules (or rather embryo-sacs) are produced. In certain of the heterosporous higher cryptogams the homologous parts are called micro-

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spores and macrospores respectively. Each of these sexual individuals undergoes further growth (reduced to a very small amount in the Phanerogams), and then, by the union of their products, *i.e.*, the sexual organs, a seed is produced. The cycle, if I understand it rightly, is thus represented by A, B; A, B; etc. In multiaxial plants the only difference is that fresh individuals may be produced by budding for many generations before the sexual generation recurs. In Ferns and Mosses the same arrangement is seen except that a spore in these cases is usually capable of giving rise to both male and female organs, though even here we meet with a decided tendency to unisexuality. Analogous cases to all these are met with in the lower groups of the animal kingdom. The agamogenesis, *i.e.*, the production of buds, may take place in different way which are called metagenesis (both external and internal), parthenogenesis, and pseudo-parthenogenesis, but space forbids me to enter into these.

It is obvious that the classification given by Herbert Spencer does not exhaust the possible modes of occurrence of homo- and hetero-genesis. It is conceivable (1) that an organism should multiply by continued agamogenesis, which might be either continual homogenesis or that combined with heterogenesis; and (2), that when gamogenesis recurs it might recur at more than one point in the cycle and under more than one form. I am not aware that any instance is known of the latter mode, but it is at least possible. There are, however, numerous instances which seem to fall under the first head, and in which proof of the recurrence of gamogenesis is wanting, although in many cases it is probable. In the realm of Fungi, *e.g.*, the whole series of the Bacteria and Yeast-fungi, the greater part of the so-called "Fungi Imperfecti"—the Hyphomycetes and Coniomycetes—the Basidiomycetes to which the larger Fungi, the mushroom, &c., belong, and scattered examples in other groups, would fall, so far as is at present known, under this head. In most of these cases we can only account for the seeming absence of gamogenesis by supposing either that it occurs in some form which has hitherto eluded research, or that these are merely parts of the life cycle of some other organisms with which their connection is as yet unsuspected or unproved, and in which the gamogenesis will be found. The subject will be better discussed in connection with a future chapter.

The essential act of gamogenesis is the "union of two centres or cells produced by different parent organisms." We find all possible stages of this union, from the fusion of two

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entire individuals, as in the Monads, and the fusion of their contents as in the Diatoms and Desmids, and in the Conjugate Algæ (for there each cell is practically a distinct individual) upwards to the higher animals and plants, in which the portion separated for the reproductive process is but an extremely small part of the parent organism.

The mysterious result of this union suggests that the cells which take part in it are specialised in some peculiar way, but the evidence goes to prove that they are rather *unspecialised;* that, in fact, in proportion as cells are specialised they are unfitted for reproductive purposes. Accepting Herbert Spencer's hypothesis of physiological units, we may say that a cell which is fitted to reproduce the species must contain all the physiological units essential for that species, and that specialisation consists in the removal of certain of these units, so that some kinds of them either entirely disappear or are reduced below the necessary standard.

The fact that the reproductive cells, in most cases, are capable of only a very slight further growth, if they remain un-united with each other, is a proof that the units of which they are composed are very nearly in a state of stable equilibrium among themselves; by their mixture, the equilibrium is destroyed and a new series of structural changes is instituted.

Why does this mixture occur, and when? Here we consider only the latter question, reserving the attempt to supply an answer to the former for a future chapter. It is found that in most cases in the higher plants agamogenesis prevails when nutrition is abundant, and that when from any cause nutrition becomes reduced nearly to the level of expenditure, that is, when active growth is beginning to cease, then gamogenesis intervenes. The same connection is observable in many animals. I need not recount these well-known instances, but it is interesting to notice that illustrations of the same law are more and more being observed among the lower plants. It has long been known that to obtain the zygospores of Mucor it is necessary to starve the plant, to grow it without access of air; and Brefeld's more recent discoveries prove that the same method is required to obtain the sexual (sclerotoid) condition of Penicillium, which in the natural state is probably very rare. In fact, the instances of the law thus connecting innutrition and reproduction are so numerous, and the exceptions comparatively so few, though well marked, that it cannot but be true as a general rule, though probably complicated with some other law (unknown) which in certain cases interferes with its action.

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ON "THE DEVELOPMENT OF A FERN FROM ITS SPORE."*

BY G. C. TURNER.

Two hundred and fifty years ago it would have been a dangerous thing to have discussed a subject so intimately connected with the powers of darkness as "fern seed." The researches of latter days have, however, cleared away from the character of ferns the "uncanny" imputations of former ages. We know now that "fern seed," though collected on St. John's Eve, will not assist even an insolvent debtor to become invisible; we know that moonwort, though gathered by the light of a hundred full moons, has not the least effect in loosening locks, bars, or fetters, nor will it with a touch

"Unshoe the new-shod steed."

We know so much, but most of us do not yet understand the curious little drama which is being acted humbly and quietly upon those minute "marchantia-like" green specks which are strewn over our ferneries and wayside banks and woods.

The development of the fern from the spore had been a mystery through all time up to the middle of the present century. The honour of the discovery of the true mode of reproduction in ferns is due to Nägeli of Zurich, who, in 1844, published a memoir entitled "Moving Spiral Filaments in Ferns," wherein he announced the existence of the bodies now called antheridia. But he did not ascertain the whole truth, for he described the archegonia as modified forms of the antheridia. In fact, he seems to have been so taken up with his "moving filaments" (movement in the vegetable world being considered as a novelty in those days) that he regarded other phenomena as of secondary interest, and evidently watched them less carefully, for he describes an archegonium filled with sperm cells which emerged from it as from the antheridia. However, in the following year Count Suminski, of Berlin, cast clearer light upon the subject, and Hofmeister and others following confirmed previous observations and added new ones.

* Transactions of Section D of the Leicester Literary and Philosophical Society. Read October 17, 1883.

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The development of the fern from the spore may be watched thus:—

Choose a frond with ripe spores, place it between drying paper for a day or two, and then shake it over prepared soil. Shaking is preferable to scraping unless you are trying to porduce new varieties; in that case the spores should be sown as thickly as possible. By "prepared soil" is meant soil that has been either roasted or scalded in order to destroy all vegetable or animal germs that may be in it. Shallow pans should be used half filled with bits of broken pot to ensure good drainage, and the surface of the soil should be made smooth by gentle pressure.

The spores should not at first be watered directly, but the pots should either stand in water (distilled or boiled), or be plunged in water once a day for a few seconds.

For more convenient observation the spores may be sown on glass or on a bit of pot; the former is rather a tedious process.

The spore, like all true spores, will germinate from any point of its surface indifferently.

All spores do not germinate equally soon, spores from Osmunda germinating much sooner than others.

Usually the spore gives rise first to a long slender filament the terminal cell of which divides and sub-divides into a flat leaf-like and usually kidney-shaped expansion termed the prothallium, but in the case of Osmunda the prothallium is formed at once, and there is no long filament.

Scattered round the margin of the prothallium and on the under side are the antheridia, which are minute cellular sacs usually stalked—(I have even seen them on the stem of the young fern)—whilst on the under surface just behind the indented portion are the archegonia, which are bottle-shaped organs, buried in the substance of the "cushion," as this part is called, because here the prothallium consists of several layers of cells, instead of a single layer, as it does nearer the margin.

The prothallium shows a decided diœcious tendency. Sometimes from a whole sporangium all the prothallia developed will bear antheridia only; in others the archegonia appear later, to be fertilised by antheridia from younger prothallia.

Under certain conditions a prothallium will produce prothallia by gemmæ, and will sometimes, though rarely, produce the new fern by a process of budding.

The antheridia which contain the sperm or antherozoid cells are protected by a wall of thin cells.

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When these sperm cells are ripe the parietal cells absorb water violently and swell up, until finally the antheridium is ruptured at the apex and the antherozoid cells escape, and out of each cell is set free an antherozoid, coiled spirally round three or four times. The finer anterior end of each antherozoid is furnished with cilia, while the other or posterior end often drags with it a vesicle containing colourless granules; this subsequently falls off and remains at rest, while the filament continues its motion alone.

Imbedded at the base of the archegonium is the central cell, and leading up from it is the central canal. The central cell divides and rounds itself off, forming a smaller cell, the oosphere. When this oosphere is ready to be fertilised the canal swells up and becomes mucilaginous, and finally watery mucilage, and the protoplasm from the canal cells is forced out of the opened neck.

The antherozoids are retained in numbers by this mucilage, several of them obtain an entrance into the canal, stopping it up—a few reach the oosphere, force themselves into it, and disappear. After thus being fertilised the oosphere swells up, develops root, and frond, absorbing in the process the protoplasm contained in the prothallium, and begins life on its own account as a seedling fern.

NOTE.—*The above account is partly condensed from Sachs's Text Book.*

KOCH'S COMMA BACILLUS.

BY W. B. GROVE, B.A.

At the Conversazione of the Midland Institute in January I exhibited a slide of this now famous microbe, which was especially interesting from its history. It was prepared by Professor Strauss, of the French Egyptian Cholera Mission (so I am informed), from bacilli grown by himself in gelatine. He prefers for the present to call it, not the Cholera Bacillus, but by the name given above. I obtained it from Dr. R. Suzor, of Paris. An examination under a sufficiently high power (a one-tenth is the lowest that is satisfactory) reveals a number of minute rod-like organisms, some single, others connected in chains of two or more, mingled with occasional threads in which no division into rods could be detected. Their most striking feature was that which gives them their common name; most of the rods were more or less bent, some so as to form about the sixth of a circle; others were quite straight, and every intermediate stage could be found,

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One of our chief biologists has attempted to parody the famous joke about the crab, by saying that Koch's Comma Bacillus is so-called (1) because it is *not* comma-shaped; (2), because it is *not* a Bacillus. But an inspection of these authentic specimens shows that he is wrong in both particulars; they *are* curved exactly like a written comma, but of course without the distinct head which we see in a printed comma. Moreover, they *do* belong to the genus Bacillus—in the Vibrio form it is true, but without the spiral which distinguishes the genus Spirillum. It is now well known that the members of the old genus Vibrio were of two kinds, some merely undulated (Bacillus), some truly spiral (Spirillum). For this reason, the word Vibrio is now dropped as a generic term.

Other observers than Koch have met with Bacilli curved in a similar comma fashion; among these one is stated to be very common in the mouth of many healthy persons, and another has just been discovered by Dr. Deneke, of Göttingen, in mouldy cheese. These all present great similarity in their form, although differing slightly in their mode of growth in nutrient media. But it is obvious that this similarity is no proof of identity. There are already numerous instances known of Bacilli which, while morphologically almost identical, are physiologically widely different, *e.g.*, the hay-bacillus and that of splenic fever, the bacillus of glanders and that of tubercle.

Through the kindness of Mr. Sampson Gamgee, of this town, my attention has been called to a book just published in Italy by Dr. A. Bianchi* containing the observations made by the famous Italian physician, Prof. F. Pacini, during the cholera epidemic in Florence in 1855. Copies are given of drawings of the micro-organisms which Pacini found in the bodies of those who died of cholera, made by him at the time, thirty years ago, but not published during his lifetime. Among these, one which he calls a Vibrio so closely resembles Koch's Comma Bacillus that it can scarcely be doubted that Pacini met with the same organism which Koch afterwards rediscovered. In one striking point this similarity is most convincing; in Koch's Bacillus it frequently happens that when two curved cells are in contact, end to end, the concavities are turned in opposite directions, thus forming a distinct S, and this feature is well represented by Pacini.

* Nuove Osservazioni Microscopiche sul Colèra (Milan, 1885), p. 4, fig. 2.

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THE FLORA OF WARWICKSHIRE.

AN ACCOUNT OF THE FLOWERING PLANTS AND FERNS OF THE COUNTY OF WARWICK.

BY JAMES E. BAGNALL, A.L.S.

(Continued from page 23, Vol. VIII.)

CYPERACEÆ *(continued).*

CAREX *(continued).*

C. Pseudo-cyperus, *Linn. Cyperus-like Sedge.*

Native: Moist, shady places, damp banks, and near pools. Local, but widely spread. June.

I. Sutton Park, nearly extinct; Bentley Park; Maxtoke; Marston Green; bank near Olton Railway Station; copse near Henfield, Knowle; pool by Barber's Coppice, Hampton-in-Arden. Earl's Wood Reservoir, with female flowers in the top of male catkin; small pool, near Three Maypoles, Shirley Heath.

II. On the edge of a pool at Kinwarton, *Rufford, Purt.*, ii, 418. Kenilworth, *Y. and B.* Side of pools and waters near Arbury Hall; Pinley, near Stoke Heath, *Kirk. Phyt.*, ii, 971. Pond near Cawston House; pond outside Frankton Wood, *R. S. R.*, 1877. Honington, *Newb.* Twelve o'clock riding, Combe Woods, 1875; abundant in a wood at Tile Hill; pond near Tile Hill Wood; Bearley Bushes; Snitterfield Bushes; Shortwood Coppice, near Tardebigg.

C. paludosa, *Good, Lesser Pond Sedge.*

Native: Near canals, ditches, marshy ground, and damp woods. Locally common. April to June.

I. Sutton Park; Middleton; in several places on the Warwick Canal from Olton to Knowle; Bradnock's Marsh; Barston Marsh; Blythe Bridge, &c.

II. Near Wroxall Abbey; Hill Wootton; near Kenilworth, *H.B.* Radford, *Y. and B.* Side of river by Little Lawford Mill, *R. S. R.*, 1877. Canal near Newbold-on-Avon; canal near Rowington; canal near Yarningale Common; Binton Bridges; pool, Combe Abbey Grounds.

Var. *b. Kochiana.* More local.

I. Pool Hollies Wood, Sutton Park; Water Works Ground, Witton Lane; Bradnock's Marsh; Blythe Bridge; canal near Hockley; Henfield; Knowle.

II. Tredington, *Newb.;* canals near Rugby, *L. Cumming;* Old Canal near Newbold-on-Avon; Binton Bridges.

This variety occurs frequently with the type, but it requires minute examination to separate them, so that it may be found in many of the districts assigned to var *a*.

C. riparia, *Curtis. Greater Pond Sedge.*

Native: Near rivers, pools, canals, and in damp woods. Locally common. April to June.

I. In most of the canals in the Tame basin; Sutton Park, very rare; Middleton; Kingsbury; Anstrey, near Tamworth; Bradnock's Marsh; Righton End; boggy coppice near Stonebridge; Meriden Marsh; Blythe Bridge, near Solihull; Henfield and Temple Balsall.

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II. Honiley, *Y. and B.;* Honington, *Newb.;* in all the canals in the Avon basin more or less abundant; Alveston Pastures Wood; Binton Bridges; wood near Spernal; Seas Pool, Arbury; pool in Combe Abbey Grounds.

A peculiar form occurs in a boggy coppice near Stonebridge in which there are female flowers and perfect fruit at both top and bottom of male spike.

C. ampullacea, *Good. Bottle Sedge.*

Native: Near pools and ponds. Very local. May, June.

I. In several pools about Middleton, *Ray, Cat.*, ed. 1, p. 145; Packington, *Aylesford, B. G.*, 636; Edgbaston Pool, *With.*, ed. 4, 110; Sutton Park, very abundant; Coleshill Pool; Marston Green; near Solihull.

II. Pit at Wroxhall, *H. B.;* Hill Wootton, *H. B.;* Milverton, *Y. and B.*

C. vesicaria, *Linn. Bladder Sedge.*

Native: In marshes, near pools, and in damp woods and copses. Local, but widely spread. May, June.

I. Packington, *Aylesford, B. G.*, 636; Edgbaston Pool, *With.*, ed. 4, 110; Kingsbury Wood; damp pastures near Coleshill; Coleshill Pool; Bradnock's Marsh; Olton Pool; osier plantation near Solihull; copse near Henfield, Knowle; Earl's Wood in several localities.

II. At the edge of a large pit near to Great Alne Mill, *Purt.*, ii, 451; Harbury, *Rev. A. Blox.;* pond by Blue Boar Lane, *Blox., R. S. R.*, 1874; pond at Frankton Wood, *R. S. R.*, 1877; Seas Pool, Arbury; Binley Common; footway from Eastern Green to Allesley; Shortwood Coppice, Tardebigg.

GRAMINA.

[*Digitaria sanguinalis*, Scop. *Mr. Bromwich* finds this as a casual weed near Kenilworth Station.]

SETARIA.

S. viridis, *Beauv. Green Bristle-Grass.*

Casual: In gardens and cultivated land. Rare. August.

II. Kenilworth, *H. B., Herb. Brit. Mus.*, Myton, on railway banks, H. B.! Leamington, *Y. and B.* Old gardens in the Southam Road, near Leamington.

[*S. glauca*, Beauv. This occurs as a weed of cultivation near Milverton, *H. B.*]

ANTHOXANTHUM.

A. odoratum, *Linn. Sweet-scented Vernal Grass.*

Native: In pastures, woods, on heath lands, roadsides, and banks. Common. April to June. Area general.

The var. *a. genuinum* is the more frequent plant on healthy pastures. Var. *b. villosum* occurs abundantly in several of the damp shady woods. I cannot think these are more than inconstant forms.

DIGRAPHIS.

D. arundinacea, *Trin. Ribbon Grass.*

Native: By rivers, streams, pools, and in drains, &c. Common, June, July.

I. Aston, in River Tame; Sutton Park; Middleton Heath; Polesworth; canal near Atherstone; Plant's Brook; Water Orton; Forge Mills; Marston Green; Bentley Heath; Temple Balsall; Earlswood.

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II. Near Leamington, *Perry Fl.;* Rugby district; *R. S. R.*, 1874, Honington; Tredington; Alveston Heath; Stratford-on-Avon; Wixford; Oversley; Rowington; Sowe Waste and Ansty Canals; pool in Combe Abbey Grounds; Binley Common.

PHALARIS.

P. canariensis, Linn. Canary Grass.

Alien: On waste heaps; and in cultivated fields. Rare, July.

I. On waste heaps near Wylde Green; roadsides near Oscott College, Old Chester Road; railway banks, Sutton Park.

II. Coventry Park, *Kirk, Herb. Perry,* near Leamington; canal side near the Cape, Warwick, *H. B.;* corn fields near Bilton, Rugby

ALOPECURUS.

A. agrestis, *Linn. Slender Fox-tail Grass.*

Colonist: In cultivated land and on roadsides. Local and common. June, July.

I. Fields near Middleton; Coleshill; Marston Green; abundant near Sheldon Church; Hampton-in-Arden; Barston Marsh; Marston Green; Henfield, near Knowle.

II. Frequent in fields near Leamington and Warwick, *H.B.;* Honington; Tredington; Armscote; Ilmington, *Newb.;* Rugby district, *R.S.R.*, 1872; Wilmcote; Lapworth.

A. geniculatus, *Linn. Bent-stemmed Fox-tail Grass.*

Native: Near pools, marshes, waysides, ditches, and other wet places. Common. May to September. Area general.

A. fulvus, *Sm. Orange-anthered Fox-tail Grass.*

Native: Near pools and ponds. Rare. June to August.

I. Edgbaston Park, *With.*, ed. vii, 151; meadows by Powell's Pool, Sutton Park, 1872; abundant on the shores of Coleshill Pool, 1875-8; marsh near Hill Bickenhill; Earl's Wood Reservoir, abundant.

II. Pit in Rounsel Lane, Kenilworth, *H.B., Herb. Brit. Mus.;* Shrewley Pool, *H.B.;* Kenilworth Old Park, *Y. and B.*

A. pratensis, *Linn. Meadow Fox-tail Grass.*

Native: In pastures, meadows, on roadsides and banks. Common. May to August. Area general.

b. pronus.

Occasionally with the type, a variety scarcely to be distinguished.

PHLEUM.

P. pratense, *Linn. Cats-tail Grass. Common Timothy Grass.*

Native: In pastures, meadows, and roadsides. Common. May to July. Area general.

b. nodosum, Linn. Local or rare.

I. Borders of a pasture footway from Righton End to Barston Marsh.

II. Near Tachbrook, *Y. and B.;* Alveston Heath! *Newb.;* Harbury Heath; sandy pasture near Rose Hall, Oversley; fields near Binton; sandy road sides near Little Lawford Mill; Combe Fields.

Var. *majus.* Very local.

II. Honington, *Newb.*; near Chesterton, *H.B.*; Harbury Heath, abundant on the borders of cornfields; in principal drive of Alveston Pastures Wood; on the borders of fields, Baddesley Clinton.

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This is a tall form, often four feet high, with spikes six or more inches long, growing singly, and usually thinly scattered on the borders of cornfields.

GASTRIDIUM.

G. lendigerum, *Gaud. Awned Nitgrass.*

Colonist: On the borders of cultivated fields. Very rare, and of uncertain occurrence. July.

II. Cornfields near Alcester, *Blox. N.B.G.S.*; Hampton-on-the-Hill; Grove Park; Norton Lindsay; Wilmcote; King's Lane, Stratford-on-Avon, *Herb. Perry*; Tachbrook, *H.B.*!

POLYPOGON.

[**P. monspeliensis,** *Desv. Annual Beard Grass.*

Casual: In waste heathy places. Rare. July.

II. Kenilworth Heath, *Dr. St. Brody*!]

Probably brought with foreign skins.

AGROSTIS.

[**A. spica-venti,** *Linn. Spreading Silky Bent Grass.*

Casual: On the borders of corn fields. Very rare. July.

II. Saltisford, *J.G.P., Herb. Perry*! Abundant in sandy corn fields, Milverton, *H.B.*]

A casual of uncertain occurrence.

A. canina, *Linn. Brown Bent Grass.*

Native: In damp woods and copses, and on damp roadsides. Local but widely spread. June, July.

I. Sutton Park; New Park, Middleton; Heathland, Atherstone Outwoods; Bentley Park; roadsides near and in Ironstone Wood, Oldbury; Bannersley Pool; marshy coppice near Packington; damp roadsides Brockhill Lane, near Balsall Street; Temple Balsall; Olton Pool.

II. Woodloes! Haywoods! *Y. and B.;* Haseley; Rounsel Lane, *H.B.*; marshy coppice near Kingswood; Old Park, Ragley.

A. alba, *Linn. White Squitch. Marsh Bent Grass.*

Native: In damp places by roadsides, pastures, and meadows. Common. June, July.

I. Sutton Park; Middleton; Temple Balsall; Arley, &c.

II. Chesterton Wood; Alveston Heath; Wilmcote; near Wootton Wawen; canal, Newbold-on-Avon, &c.

b. stolonifera. Rare.

II. On sandy banks, old railway cutting near Henley-in-Arden.

A. nigra, *With. Black Squitch; Black Bent Grass.*

Native: On the borders of cultivated fields, railway sidings, old brickyards and waysides. Local, but widely spread. July, August.

I. Sutton Park, on railway sidings abundant; in like places at Penns and Castle Bromwich; lane by The Grange, Erdington; borders of fields, near Bentley and Hartshill; Tamworth; Temple Balsall; brickyard near Berkswell Station; fields, Meriden, &c.

II. Borders of fields near Itchington; marly banks near Chesterton Wood; borders of fields, Alveston Heath; Wilmcote; fields and lanes, Ragley and Alcester; Tile Hill; Allesley; Kenilworth; Stoneleigh.

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More robust, with rough leaf sheaths and more strongly-toothed spikelets rachis and pedicels, ligule more prominent, and flowering nearly a month later than *A. vulgaris*.

A. vulgaris, *With.* *Common Bent Grass.*

Native: In pastures, meadows, roadsides, and banks. Common. June, July. Area general.

b. pumila. Rare. Wet sandy places.

I. Above Blackroot Pool, Sutton Park; wet sandy roadsides near Stonebridge.

II. Lye Green! *Herb. Perry.* Honily, *H. B.!* Haseley Common; Sitch field, Chesterton; near Hatton, *H. B.*

CALAMAGROSTIS.

C. Epigejos, *Roth.* *Wood Small Reed.*

Native: In woods and shady damp places. Local. July.

I. Upper stew in Edgbaston Park, *With.*, ed. 7, 197; small wood near Tyburn, *F. Terry!* wood at Walmley, *J. B. Stone!* Coleshill Pool; Arley Wood.

II. Dunington; Salford; Wetherly, *Purt.* i., 178; woods at Alcester, *Blox.;* Allesley, *Bree, Mag. Nat. Hist.* iii., 163; Brandon Wood; near Arbury Hall, *T. Kirk, Phyt.* ii., 972; Stoneleigh, *T. K., Herb. Brit. Mus.;* Moreton Morrell, *Y. and B.;* Tachbrook and Harbury; Lighthorn Roughs; Grove Park! *H. B.;* between Shipston and Darlingcote, *Newb.;* Alveston Pastures; Warwick Old Park; Chesterton Wood; Oversley Wood; Old Park Wood, Ragley; Bearley Bushes; Combe Woods; Prince Thorpe Wood; Ufton Wood; Wayland Coppice.

C. lanceolata, *Roth.* *Purple-flowered Small Reed.*

Native: In damp woods and near pools. Very rare. July.

I. Olton Pool, *J. Bagnall, Herb. Brit. Mus.*

II. Near Griff, *T. Kirk, Herb. Brit. Mus.;* Binley Bogs, *T. K., Herb. Perry;* Ufton Wood.

PHRAGMITES.

P. communis, *Trin.* *Common Reed.*

Native: On river banks, near pools, and in damp shady places, &c. Locally abundant. August, September.

I. Near Sutton; near Polesworth; Bole Hall, Tamworth; Plant's Brook Reservoir; near Water Orton railway cutting; footway from Marston Green to Elmdon; Olton Pool; canal bank between Baddesley Clinton and Baker's Lane, near Knowle.

II. Honington; Tredington, *Newb.*, near Bilton! Wolston! *R.S.R.*, 1877; Alveston Pastures; Stratford-on-Avon; Oversley; Claverdon; Eastern Green, near Coventry; Kenilworth; Warwick; Tachbrook; banks of the Leam, Leamington; canal from Radford Semele, near Quinton Mills; Pool in Combe Abbey Grounds.

MILIUM.

M. effusum, *Linn.* *Wood Millet Grass.*

Native: In woods and on shady banks. Local. May, June.

I. Arley Wood; Kingsbury Wood; Bentley Park; Hartshill Hayes; Meriden Shafts; Spring Coppice, Hockley.

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II. Ragley! and Oversley Woods! *Purt.*, i, 72; Haywoods; Honily, *Y. and B.;* near Guy's Cliff; Woodloes; Fern Hill Wood! Gilbert's Coppice, Rowington, *H.B.;* woods, Edge Hills; Alveston Pastures; Austey Wood, near Wootton Wawen; woods, near Claverdon; lanes about Lapworth; Haywoods; Quarry Lane, Rowington; Crackley Wood, Kenilworth; Cubington Wood; Brandon Wood; Combe Woods.

DESCHAMPSIA.

D. cæspitosa, *Beauv.* (*Aira cæspitosa*, L.) *Tufted Hair Grass.*

Native: Near rivers, streams, pools, drains, and on damp roadsides. Common. June—July. Area general.

A variety closely approaching var. *brevifolia* occurs in Sutton Park and near High-down, Tachbrook.

D. flexuosa, *Trin.* (*Aira flexuosa*, L.) *Heath Hair Grass.*

Native: on heaths, heathy roadsides, banks, and in open woods. Locally abundant. June, July.

I. Dry woods in Sutton Park! *With.*, ed. 7, 161. Middleton Heath; Trickley Coppice, New Park; Bentley Park; heath lands near Atherstone Outwoods; Baxterley and Baddesley Commons; Bannersley Rough; Coleshill Heath; Marston Green; Hampton-in-Arden; lanes about Solihull and Knowle; Hockley; Earlswood; Forshaw Heath.

II. Haywoods! *Y. and B.* Spinney between Blue Boar and Wolston! Near Overslade, Dunchurch Road; *R. S. R.*, 1877. Kenilworth; Oversley; Combe Woods, &c.

A form remarkably like the var. *b. montana* is occasional on exposed heath lands, Sutton Park; and a robust form with long ligule, but in other matters like the type grows in boggy and damp woods in Sutton Park and near Earlswood.

AIRA.

A. caryophyllea, *Linn. Silver Hair Grass.*

Native: On sandy heaths, roadsides, pastures, and banks. Local and rare. June, July.

I. Common about Edgbaston, *Freeman, Phyt.* i. Atherstone Outwoods, *Herb. Per.* Sandy banks, Gravelly Hill; roadsides near Wylde Green Railway; sandy waysides, Hill, near Sutton; Middleton Heath; Atherstone Outwoods; Coleshill Heath; Hill Bickenhill; Bannersley Rough; Hampton-in-Arden.

II. In Oversley Wood on a sandy bank, *Purt.*, i., 73. Milverton; Kenilworth, *Y. and B.* Yarningale Common! *H. B.* Near Brandon.

A. præcox, *Linn. Early Hair Grass.*

Native: On heaths and heathy roadsides. Local. April, May.

I. Roadside near Wylde Green Railway Station; Sutton Park; Middleton Heath; Hartshill Stone Quarries; Baddesley Common; Bannersley Rough; Coleshill Heath; Hampton-in-Arden; Forshaw Heath; Earlswood.

II. Whitnash; Tachbrook! *Y. and B.* Sandy field, Milverton, *H. B.* Kenilworth Heath.

TRISETUM.

T. flavescens, *Beauv. Yellow Oat Grass.*

Native: In meadows, pastures, and on roadsides and banks. Rather common. June, July.

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I. Canal bank, Gravelly Hill; pastures near Sutton Park; Middleton; Ansley; Baddesley Ensor; Baxterley; Kingsbury; Coleshill; Marston Green; Solihull; Knowle; Temple Balsall; Earlswood, &c.

II. Sherbourn, *Y. and B.* Honington, Tredington, *Newb.*, Edge Hills; Kineton; Alveston Heath; Stratford-on-Avon; Binton; Wixford; Salford Priors; Oversley; Henley-in-Arden; Foleshill; Combe Fields, &c.

AVENA.

A. pubescens, *Linn. Downy Oat-Grass.*

Native: In pastures, heathy commons, and on roadsides in marly and calcareous soils. Locally abundant. May, June.

I. Slade Lane, Witton; pasture near Sutton; lane by Erdington Grange; Sybill Hill, near Kingsbury; Oldbury; Baddesley Ensor; Coleshill; meadows near Blythe Bridge, Solihull.

II. Myton, Chesterton! *Y. and B.* Tredington, *Newb.*, Wroxall; Longbridge, Warwick, *H. B.* Farnborough, near the village; Marl cliff, near Bidford; roadside between Alcester and Stratford; Bardon Hill; Foleshill.

A. pratensis, *Linn. Glabrous Oat Grass.*

Native: In pastures, and on roadsides and banks in calcareous soils. Rather rare. July.

I. Roadside near Bradnock's Marsh, June, 1882.

II. Lighthorne; Tachbrook; Compton Verney, *H. P.* Chesterton! *Y. and B.* Tredington! *Newb.* Oversley Hill, near the wood; Warwickshire meadows, Salford Priors; Marl cliff near Bidford; roadsides between Stratford-on-Avon and Drayton Bushes; pastures near Shottery; Bardon Hill.

[*A. strigosa,* Schreb. *Black Oat.*

Casual: In corn fields. Rare. July.

II. Casual about Myton, *H. B.* Moreton Morrell, in wheat fields.]
A casual of very uncertain occurrence.

A. fatua, *Linn. Wild Oat.*

Colonist: In corn and other cultivated fields. As an aggregate species locally common. July.

a. pilosissima. Rather common.

I. Long Lane, Sutton; near Over Green, Wishaw, Curdworth; Hartshill; Coleshill; Marston Green.

II. Whitnash; Tachbrook, *Y. and B.* Lambcote; Stratford-on-Avon *Newb.* Wixford; Binton; Exhall; Alne Hills; near Rugby.

b. intermedia. Local or rare.

II. Myton, *H. B.*, Alne Hills; Spernall Ash.

c. pilosa. Rare.

II. Harbury, *H. B.*! Cultivated fields near Stratford-on-Avon.

The two latter varieties have probably a more extended range than is given here, but sufficient attention has not been given to them to allow of fuller record.

(To be continued.)

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Reviews.

Magnetism and Electricity. By Professor F. Guthrie. New edition, revised by Mr. C. V. Boys; 428 pp., 323 illustrations. Published by W. Collins and Sons; price 3s. 6d.

The large circulation of Professor Guthrie's book—it has now reached its twentieth thousand—is the natural result of the high merit of the book and its low price. To the present edition Mr. Boys has added a valuable chapter dealing with electrical measurements and with the wonderful discoveries which have rendered the last few years famous in the history of electricity.

The Student's Elements of Geology. By Sir C. Lyell. Fourth edition, edited by Professor P. M. Duncan. 621 pp., 8vo.; 636 woodcuts; price 9s. Published by J. Murray.

Students will hail with pleasure the appearance of a new edition of "Lyell's Elements," a standard work which has been out of print for several years. It has been revised with great care by Prof. Duncan, who has incorporated with the book the most recent geological discoveries, including even Prof. Geikie's acknowledgment of the true arrangement of the rocks of the Highlands, a statement only published a few weeks ago. The illustrations, which are very numerous, appear to have been re-drawn, as they are as fresh as those of the first edition. The Table of British Fossils given in the appendix, which extends over twenty-two pages, and shows at a glance the successive appearance and development in time of the chief orders, classes, or families of animals and plants, is a valuable feature. There can be no doubt but that this book still remains the best general text-book of geology—considering its fullness of detail, the fact that it is contained in one volume, and its moderate price. W. J. H.

METEOROLOGICAL NOTES.—December, 1884.

The barometer was unsteady throughout the month—fluctuating between 29·1 inches and 30·1 inches until the 20th, when it fell to 28·857 inches, and rose in forty-eight hours to 30·311 inches, remaining high during the remainder of the month. Temperature was about the mean, and was variable in the earlier part of the month. The highest maxima were 57·7° at Hodsock, on the 13th; 54·2° at Loughborough, 54·0° at Henley-in-Arden, and 53·3° at Coston Rectory, on the 6th; and 52·8° at Strelley, on the 13th. In the rays of the sun 84·2° was registered at Hodsock, on the 13th; 76·9° at Loughborough, on the 5th; and 72·3° at Strelley, on the 7th. The lowest minima occurred on the 31st, and were 22·0° at Coston Rectory, 23·3° at Hodsock, 24.0° at Henley-in-Arden, 24·6° at Loughborough, and 25·6° at Strelley. On the same date the thermometer on the grass recorded 18.7° at Strelley, 19·4° at Hodsock, and 21·7 at Loughborough. The rainfall was below the average, and consisted of small amounts. The 12th and 15th were the only days before the 21st on which there was

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not a fall of 0·01 of an inch or more. The latter portion of the month was generally dry. The total values were 2·58 inches at Henley-in-Arden, 2·19 inches at Strelley, 2·06 inches at Coston Rectory, 2·01 inches at Loughborough, and 1·45 inches at Hodsock. The heaviest fall in one day was 0·44 inches at Coston Rectory, on the 18th. Snow fell on the 1st, 17th, 18th, and 20th. At Loughborough a lunar halo was seen at 6 a.m. on the 8th, and on the afternoon of the 18th lightning and thunder were observed, and distant lightning in the evening of the same day. Sunshine was deficient. Gales, chiefly S.W., were experienced on the 2nd, 7th, 10th, and 18th.

Wm. Berridge, F.R.Met.Soc.

12, Victoria Street, Loughborough.

Natural History Notes.

British Moss Flora.—In the notice of this work, Vol. VIII., p. 25, it should have been stated that Part X. will conclude Vol. I., not Part IX., as there stated.

Flora of Derbyshire.—The Rev. W. Hunt Painter, has for some time past been engaged in preparing a new Edition of his "Notes on the Flora of Derbyshire," and has made numerous additions thereto both of Plants and Habitats. It will be issued to subscribers, as soon as printed, at 2/6 per copy. Subscribers' names may be sent to Messrs. Wright, Dain, Peyton, and Co., "The Herald Press Office," Birmingham.

Objects for the Microscope.—Messrs. James Carter and Co., 237, High Holborn, London, W.C., announce in their new seed catalogue for the present year that they are prepared to supply curious seeds for microscopic objects to those who desire them, at the following rates:—12 varieties for 2s. 6d., 25 for 5s., 50 for 10s. 6d., and 100 for 21s. This is the first occasion on which, so far as we know, such an offer has been made by either of our largest seedsmen, who must have unusual facilities for supplying the microscopist with many interesting opaque objects.

Additions to the Flora of Sutton Park.—I am pleased to say that two very interesting additions to this flora—as recorded in the "Notes on the Flora of Sutton Park"—have been made, namely, *Wahlenbergia hederacea* and *Lycopodium clavatum*. *Wahlenbergia hederacea* has been found associated with *Anagallis tenella* in several places by my kind friend Mr. A. W. Wills. This is a very pleasing addition and one that I had always expected would be found in this locality, as there are in this place all the natural surroundings required by such a plant. *Lycopodium clavatum* has also been found in this locality by Miss Ethel Stone, of Erdington, a young lady who takes great interest in botanical science, and whose more keen observation has enabled her to find a plant for which I have searched hitherto in vain. *Lycopodium clavatum* is recorded for "Sutton" by Samuel Freeman in the "Phytologist" for July, 1842, page 262, but as Miss Stone had never heard of this record her discovery of the plant in Sutton Park is as truly an original one as was Freeman's. When the "Notes on the Flora of Sutton Park" was published I was not aware of the existence of Freeman's paper, hence was unable to acknowledge—as I should gladly have done—his priority of record in the case of some of the rarer plants I have therein recorded. J. E. Bagnall.

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The JACKDAW.—It may be interesting to some of your readers to know that a pair of jackdaws located themselves for a time in the very heart of the busiest part of Birmingham. In the spring of last year these birds took possession of the elevated spire of the Cobden Coffee House, in Corporation street. During the nesting season it was most amusing to see the way in which the birds supplied themselves with building material. From daylight until about 8 a.m. the pair were engaged in collecting sticks, &c., which were deposited on the roof of an adjoining building. The remainder of the day was occupied in carrying supplies from the store to the nest. Occasionally the birds would perch on the vane—one at each end—and on a windy day the vane would actually go round without at all disturbing the occupants of this exalted position. Though the nest was prepared, and one or other of the birds was to be seen daily during the period of incubation, it is somewhat doubtful whether young birds were hatched. It was not until September that any increase in numbers was noticed; but on this occasion there was considerable commotion round the spire, four pairs of birds being observed, all apparently making a careful examination of the amount of accommodation available for another season. It would be interesting to know the district from which these jackdaws came, and why they selected a place so far from any feeding ground. It appears somewhat remarkable that they should have selected this new spire in preference to the larger and older building of St. Philip's Church, which is only about a hundred yards distant. At the present time (January) the place is visited daily for about two hours by one pair of birds only. W. H.

NITRATES.—Of the salts just mentioned, the nitrates are of extreme importance, inasmuch as nitrogen is an essential constituent of protoplasm—without nitrogen there can be no protoplasm, without protoplasm there can be no plant. The nitrogen is supplied to the plants from the soil in the form either of nitrates (potassic nitrate, sodic nitrate), or of ammonia salts in which the nitrogen is in combination with hydrogen. The ammonia in the soil is made to combine with oxygen, and thus to form nitric acid, through the agency of minute organisms called "Bacteria," which, like the yeast fungus, act as ferments; and by their agency it is, as Mr. Warington has pointed out, in confirmation of the researches of Schloesing and Muntz, that the ammonia salts, which themselves are inert, or it may be harmful, get converted into useful nitrates. Ammonia salts applied to some soils do no good, because the needful germs or ferment bodies are not present in the soil; but where they do exist, they convert the useless into the useful, as before said. These bacteria occur in all fermenting material, such as farmyard dung, whose value as manure is in part accounted for by their presence and agency. It is probable in the future that just as the brewer uses his yeast to secure the conversion of starch into sugar, and the chemist "seeds" his solutions to effect the changes he wishes to bring about, and just as the gardener sows the spawn or germs of mushrooms in his mushroom bed, and obtains thereby a crop of succulent fungi, so the farmer may be able to apply to the soil the ferment-producing germs needed to change its quality, and render it available for plant food. When we have arrived at that point, manuring will be reduced to a science, and a pinch of the right material will be as efficient as a ton of our present compounds, the larger part of which are undoubtedly wasted under existing circumstances.—Dr. MAXWELL T. MASTERS, F.R.S., in his "*Plant Life.*" (London: Bradbury, Agnew, and Co.)

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How and Why.—No torn scrap of that very sea-weed, which to-morrow may manure the nearest garden, but says to us, "Proud man! talking of spores and vesicles, if thou darest for a moment to fancy that to have seen spores and vesicles is to have seen *me*, or to know what I am, answer this. Knowest thou how the bones do grow in the womb? Knowest thou even how one of these tiny black dots, which thou callest spores, grow on my fronds?" And to that question what answer shall we make? We see tissues divide, cells develop, processes go on—but how and why? These are but phenomena; but what are phenomena save effects? Causes, it may be, of other effects; but still effects of other causes. And why does the cause cause that effect? Why should it not cause something else? Why should it cause anything at all? Because it obeys a law. But why does it obey the law? and how does it obey the law? And, after all, what is a law? A mere custom of Nature. We see the same phenomenon happen a great many times; and we infer from thence that it has a custom of happening; and therefore we call it a law: but we have not seen the law; all we have seen is the phenomenon which we suppose to indicate the law. We have seen things fall: but we never saw a little flying thing pulling them down, with "gravitation" labelled on its back; and the question, *why* things fall, and *how*, is just where it was before Newton was born, and is likely to remain there. All we can say is, that Nature has her customs, and that other customs ensue, when those customs appear: but that as to what connects cause and effect, as to what is the reason, the final cause, or even the *causa causans*, of any phenomenon, we know not more but less than ever; for those laws or customs which seem to us simplest ("endosmose," for instance, or "gravitation") are just the most inexplicable, logically unexpected, seemingly arbitrary, certainly supernatural—miraculous, if you will; for no natural and physical cause whatsoever can be assigned for them; while if anyone shall argue against their being miraculous and supernatural on the ground of their being so common, I can only answer, that of all absurd and illogical arguments, this is the most so. For what has the number of times which the miracle occurs to do with the question, save to increase the wonder? Which is more strange, that an inexplicable and unfathomable thing should occur once and for all, or that it should occur a million times every day all the world over?—Charles Kingsley.

Mr. James E. Bagnall.—Mr. Smiles, in his charming "Life of a Scotch Naturalist, Thomas Edward, Associate of the Linnean Society," has told the history of one of the most zealous naturalists that ever lived—a man who, under the most adverse circumstances, made great and important additions to natural knowledge. In 1866 these arduous labours were signally recognised and, in a sense, rewarded by his being elected an Associate of the Linnean Society. The society never has more than twenty-five Associates on its roll of members, and Edward's biographer very accurately says of him when he became one of the number, that it was "one of the highest honours that science could confer upon him." Not only is it an honour to be elected an Associate, but the honour is all the greater inasmuch as no one is elected who has not done some really good work in at least one branch of Natural History. It is, therefore, a source of much pleasure to us to be able to announce that this honourable distinction has lately been conferred on our much-respected contributor, Mr. James E. Bagnall, of Birmingham, who, at a recent meeting of the Linnean Society, was unanimously elected an Associate, the proposition being made,

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seconded, and supported by several eminent scientific men. Mr. Bagnall is one of the Vice-Presidents of the Birmingham Natural History and Microscopical Society, of which he has for something like a quarter of a century been one of the most useful and hard-working members. He has devoted his principal attention to the study of botany—structural and systematic. Years since he won for himself a name as a bryologist. He has communicated numberless papers to the Society, and scarcely a meeting has taken place for a very long period at which he has not exhibited some plant "new to the district" or of great rarity. He has always been a ready helper to young beginners, and many local botanists have benefited by his assistance. Many of his contributions have appeared in the scientific journals. His most important published work is the latest and by far the best "Flora of Warwickshire," which has appeared by instalments extending over several years in the pages of this magazine. This important work will, we are informed, shortly appear in a thoroughly revised form as an independent publication. We cannot entertain a doubt that it will be warmly welcomed by botanists in all parts of the kingdom, for it has already won the reputation of being one of the fullest and most carefully prepared county floras in the English language. If we are not misinformed, Mr. Bagnall has achieved his success as a scientific man in the leisure hours of a working life spent in one of our large manufactories, where he has been as "diligent in business" as he has been diligent in observation and study when the day's work has been finished.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Microscopical General Meeting, January 20th, 1885.—The following resolution was passed:—"That this meeting desires to express its sincere sorrow and regret at the loss which the Society has sustained by the death of their Assistant Curator, Mr. Cox, who fulfilled the duties of his office with satisfaction to the Society, and advantage to the members; and this meeting further desires to express its sympathy with Mr. Cox's relatives on this occasion." Mr. W. R. Hughes, F.L.S., exhibited *Arbutus unedo*, in flower and fruit, from Colwyn Bay, North Wales. Mr. W. H. Wilkinson exhibited *Glyceria fluitans* from the warm water of a canal at a Wolverhampton Iron Works. Also some large acorns from a tree near the Wrekin, Shropshire, probably *Quercus albus*, an American species of Oak, brought into cultivation here about 1793. Mr. R. W. Chase exhibited rare varieties of the following birds:—Variety of *Fringilla cœlebs*, from Small Heath; *Sylvia cinerea*, from Tamworth; *Erithacus rubecula*, from Burton; *Sturnus vulgaris*, local; *Tringa minuta*, from Breydon Broad; also nests and eggs of *Erithacus rubecula*, *Anthus obscurus*, *Fringilla cœlebs*, *Motacilla raii*; and clutches of eggs of *Accipiter nisus*, and *Larus fuscus*. All the above eggs were of unusual colouring. Mr. W. B. Grove, B.A., exhibited under the microscope, Koch's Comma Bacillus, from a specimen cultivated in gelatine, put up by Dr. Strauss, of the German Cholera Commission. This is the alleged germ of cholera, and there is great probability that the allegation will be proved. The opinions which

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have been expressed against it are all unsupported by trustworthy experiments. In opposition to Professor Ray Lankester's published opinion, it may be stated that these specimens are comma-shaped, *i.e.*, curved in a sixth of a circle, but of course without the head, and also are a true species of Bacillus in the vibrio form.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—December 22nd.—Mr. Deakin exhibited specimens of land shells of the following genera:—Helix, Clausilia, and Bulimus, from Mount Carmel, Palestine; also carvings in soapstone, from Agra and Ceylon. Mr. Moore, a collection of named marine shells from Ceylon. Mr. Madison, the following shells:—*Helix irce*, from Queensland; *H. pennsylvanica*, from Ohio; and *Planorbis corneus*, from Slavonia. Mr. J. W. Neville, Permian marl, with fern impressions. Mr. J. Betteridge contributed his fourth paper on "Birds of the District." January 5th.—Mr. Moore exhibited a collection of foreign shells, *Cypræa canrica*, *C. audria*, *C. caput-serpentis*, etc., etc. Mr. Madison, *Unio luteolus* and *Anodonta subcylindrica*, from United States. Mr. Hawkes, a specimen of Pinnothere from shell of mussel. Under the microscope Mr. Dunn showed *Canthocamptus minutus*. Mr. J. W. Neville, Foraminifera, dredged off coast of Galway. January 12th.—Mr. Moore exhibited specimens of *Nerita virginea* and other foreign shells. Mr. Hawkes, a collection of plants from Llandudno, including *Echium vulgare*, *Statice Limonium*, and *Gentiana Amarella*. Under the microscope Mr. J. W. Neville showed a polyzoön, *Membranipora membranacea*, from New Zealand.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY.—SECTION D.—ZOOLOGY AND BOTANY.—Chairman, F. T. Mott, F.R.G.S.; monthly meeting, January 21st; attendance, twelve (four ladies). Exhibits: Fruit of the Mango (*Mangifera indica*) and the Butter-nut (*Caryocar nuciferum*) by the Chairman. Branch of *Ribes speciosum* from a garden in Hampshire, showing its numerous triple spines and young winter leaves, by Miss Grundy. The large common lichen, *Peltigera canina*, with abundant fruit, by Mr. Grundy. Papers (1), by Mr. F. Bates "On two rare filamentous algæ new to the county," viz., *Œdogonium platygynum* and *Œ. œlandicum*, the former only recorded hitherto from Ireland, and the latter entirely new to Great Britain. These very interesting plants Mr. Bates had discovered in bogs and pools on Charnwood Forest, and he exhibited under the microscope admirably prepared slides showing the oögonia in several stages, and with the dwarf males attached. The paper described the extraordinary and complex process of fecundation in this remarkable group. (2) By Mr. H. G. Quilter, "On some Analogies between Plant and Animal Life," showing how both originated from the simple cell, how the processes of development were nearly similar in each case, and how all the attributes and functions of animals might be traced in plants also, only in a less advanced stage, and on a lower level. (3) By Mr. F. T. Mott, "On *Acaulon* (*Phascum*) *muticum*, one of the smallest Leicestershire mosses." This minute moss, one-twelfth of an inch in height only, he had found in his own garden in company with *Phascum cuspidatum* and *Pottia truncata*. It had only once before been recorded for the county, viz., by the Rev. A. Bloxam at Congerstone. Several specimens were exhibited prepared as microscopic slides by Mr. J. H. Garnar, also some specimens of the smallest flowering plant, *Wolffia arrhiza*, for comparison of size. This small moss was specially notable for its beautiful little bright red globular capsule.

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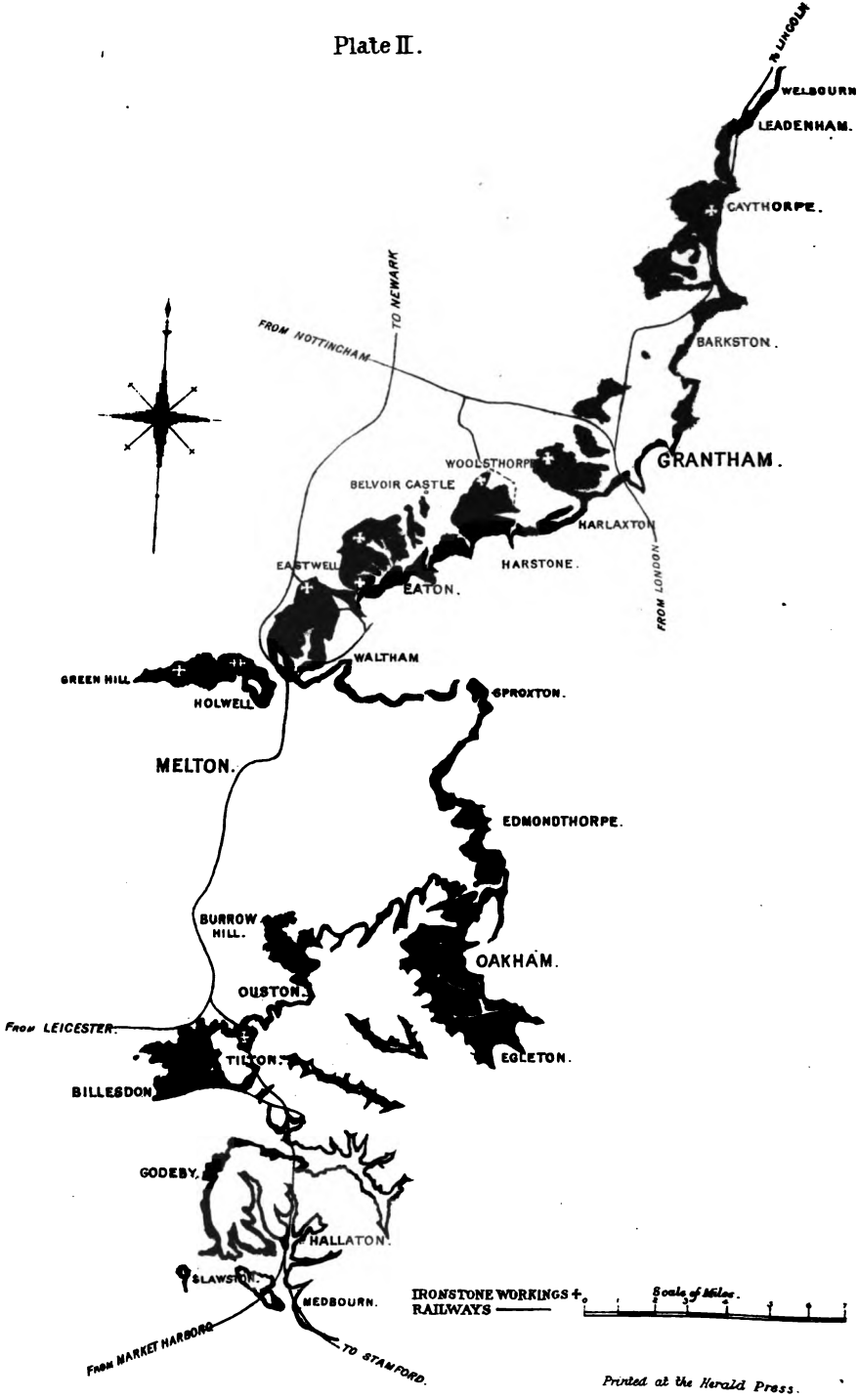
Plate II.



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MAP OF THE LIAS MARLSTONE ROCK IN THE LEICESTERSHIRE DISTRICT.

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THE LIAS MARLSTONE OF LEICESTERSHIRE AS A SOURCE OF IRON.

BY E. WILSON, F.G.S., CURATOR OF BRISTOL MUSEUM.

The *Marlstone Rock* or *Rock Bed* is a hard, ferruginous, earthy, and highly fossiliferous limestone, passing into an ironstone, which lies in the midst of the softer shales of the Lias formation. It constitutes the upper member of the Middle Lias series, the lower member comprising a series of sandy shales, which graduate into the underlying clays of the Lower Lias.

From the large amount of iron it contains, the Marlstone Rock has during the past ten or twelve years acquired a considerable commercial importance, and the mining industry to which it has given rise in the Leicestershire district is, without a doubt, destined in the future to attain far greater dimensions than it has at present reached. In times long passed, and of which we have no historical record, the rock bed was worked for iron both in Leicester and Rutland, as is evidenced by the ancient slags which are occasionally met with. Having fallen into disuse, however, its value as a source of iron has been, until quite recently, either entirely overlooked or altogether underestimated. For many years past it has been quarried for building, road metalling, and lime burning, and for all of these purposes it is still to a certain extent used. During the construction of the new local lines of the Great Northern Railway Company, the Marlstone met with in the cuttings proved of considerable service both for the building of bridges and the ballasting of the line.

The rediscovery of the Leicestershire ironstone in modern times appears to have been made by Mr. I. A. Knipe, who also constructed a geological map of the Belvoir district where the ore occurs, and brought it to the notice of the Duke of Rutland. This was prior to 1855, in which year a trial of the marlstone from Croxton was made at the furnaces of the Clay Cross Company. At that period, however, there were no means of getting the stone away, and it was mainly on that account, I believe, that no further steps were then taken in the matter. To Mr. R. Dalgliesh, manager of the Holwell Iron Company, and Mr. H. A. Allport belongs the credit of having been the first to actually commence the working of the Leicestershire Marlstone for iron, and thus to give the ore a commercial value. Mr. Dalgliesh,

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while employed on the parliamentary survey of the Nottingham and Melton line for the Midland Railway Company, was struck by the redness of the ground in the neighbourhood of Holwell, and concluded that there was iron there. In the year 1873 Messrs. Dalgliesh and Allport examined the district. Samples of the Holwell ironstone were procured and sent to Mr. E. Riley, F.C.S., of London, to be analysed, and that gentleman gave a very favourable report of the stone. A large sample of the ore was in the following year sent to Staveley to be smelted. The result proved the correctness of Mr. Riley's opinions, the stone turning out easy to smelt, and the pig-iron produced from it being of good quality. In 1875 a company was formed and a lease of the ironstone obtained. In the following year a mineral branch line was constructed from Holwell to the Midland Nottingham and Melton line near Asfordby, and the district was thus opened out, and the ironstone got into the market. At first the Holwell Company sent the whole of their ore to the Staveley Company and other large iron smelting firms in Derbyshire and elsewhere. In 1881 they erected a couple of furnaces at Asfordby, near Melton Mowbray, and since that year they have smelted the bulk of the ironstone they have got in the district at their own works. At the present time they have a third furnace ready to put into blast. These, it should be mentioned, are the only furnaces in the Leicestershire ironstone field, and at Asfordby the manufacture of iron is carried on with due regard to the most approved scientific methods.

The Marlstone Rock as a formation—though not for the whole distance as an available source of iron—extends uninterruptedly through the district for a distance of thirty-five miles, namely, from Welbourn in Lincolnshire, on the north, to Medbourn, near Market Harborough, on the south. Within these limits its prevailing north-easterly strike varies somewhat, whilst its thickness varies very considerably. Owing to these causes and to subsequent unequal atmospheric denudation, as also to the effects of at least one considerable fault, its outcrop is extremely irregular. The maximum thickness of thirty feet is attained in the middle part of its range, or between Barrowby, near Grantham, and Scalford, near Melton. When followed north and south of these two points, the Marlstone is found at first gradually, and then more rapidly to thin away and eventually to die away altogether.* Hence, we may look upon the Leicestershire

* The Marlstone also displays a tendency to attenuate in an easterly direction.

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Marlstone as a lenticular mass of rock enclosed in the Lias shales. From its superior hardness, the Rock-bed has been able to withstand denudation to such an extent that, when well developed, it forms an elevated table land or terrace from half a mile to two miles in width, rising with a gentle inclination from the base of the slopes of the Upper Lias shales on the east, and terminating in a bold escarpment overlooking the Lower Lias country on the west. This escarpment has in many places become deeply indented by valleys, and carved into promontories and even outliers through the wearing action during the course of ages of the many streams that breach its face. The porosity and extensive jointing of the exposed Rock-bed, which rests upon comparatively impervious clays, render it a copious reservoir for water. Most of the brooks of the adjoining Lower Lias district take their origin in springs thrown out at its base.

The Marlstone Rock shows great variations in mineral character. When quarried in an unweathered state in deep pits or under beds of impervious clay, it is a hard crystalline rock of a bluish-green tint, but where it has for a length of time been exposed to the disintegrating influences of the atmosphere it becomes, owing to chemical changes to be hereafter explained, of a rusty brown colour, and porous and friable in texture. At the surface the marlstone breaks up into a very characteristic deep red ferruginous soil, which forms an excellent corn land, and contrasts in a marked manner with the pasturage of the adjoining country occupied by the heavy clays above and below. Trees attain a large growth on this rock, and root-crops, as well as all the cereals, thrive upon it.

In a general way the Marlstone Rock consists of two very distinct portions—an upper and a lower—each of which constitutes, roughly speaking, about half its entire thickness. When the rock is in an unweathered state, this distinction is not very obvious to the eye, though it comes out on analysis. In the brown or weathered condition, however, the difference of these two portions is readily discerned. The upper part then appears as a highly ferruginous laminated limestone, the lower as massively bedded, but softer and more or less concretionary sandstone. It is a noteworthy fact that only the *upper* portion of the Marlstone is sufficiently rich in iron to pay for working, so that even when that rock attains a thickness of twenty-five feet or more the ironstone beds actually worked will not at the outside exceed some eight or ten feet. If then these upper beds are absent, the Marlstone will be unproductive of iron. Some beds of the Marlstone are crowded with

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fossils, though they belong as a rule to a very limited number of species. These beds, termed "Jacks" by the quarrymen, are made up of an agglomeration of the shells of Rhynchonella tetraedra and Terebratula punctata, associated with which we also find Belemnites paxillosus and Belemnites elongatus. The latter forms serve to distinguish the Lias marlstone from the Northampton Sands ironstone, to which it bears a considerable lithological resemblance, but from which it is both geologically and mineralogically quite distinct. Certain beds are almost entirely composed of encrinite fragments or of broken shells. Now and then an Ammonites spinatus will turn up, but this, the characteristic fossil of the Marlstone horizon, is in the Leicestershire district generally characteristic by its rarity or entire absence. The bottom bed of the Marlstone usually contains small flattish phosphatic nodules in such numbers as to give the rock a conglomeratic aspect.

Having described the general features of the Marlstone Rock, as exhibited in the counties of Leicester, Rutland, and (South) Lincoln, I will now proceed to notice in somewhat greater detail its varying character and thickness, and in particular its mineral products and organic remains within the limits of the above district. For convenience we will commence in the centre of Rutland, a typical Marlstone country, and thence trace the rock southwards towards Northamptonshire, and northwards into Lincolnshire.

In the neighbourhood of Oakham the Rock-bed, though only eight or nine feet in thickness, covers a very extensive area of low-lying ground forming the floor of the famous Vale of Catmos. Its decomposition gives rise to the highly productive red soil for which this district is renowned, and which probably gave the name Rutland (Red-land) to the county. A little further to the south this rock may be seen forming terraces on the sides of the valleys of the Chater and Gwash. To the north of Oakham, about Teigh, Edmondthorpe, and Wymondham, the Marlstone Rock stands out as a bold escarpment on the west, with a gentle dip-slope to the east. Going westwards from here we find the Rock-bed stretching out by Whissendine and Pickwell to terminate in the bold promontory of Burrow-on-the-Hill. This district, diversified as it is by deep valleys and surmounted by the cliff-like masses of the Rock-bed, displays hereabouts really picturesque scenery. Bending round by Somerby and Ouston the Marlstone sends out another fine branch by Tilton to Billesdon. This western projection of the Marlstone is due to the preservative influence of the great Billesdon and Lodington fault, which has a downthrow to the north of

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fully 150 feet. In this neighbourhood, the Marlstone attains more than twice the thickness it exhibits in the Oakham district. In the vicinity of Tilton there are several interesting exposures of the Marlstone Rock. It is finely displayed in the railway cutting south of Tilton Station in its grey unweathered form beneath a thick capping of Upper Lias shales, and in this section its junction with the underlying Middle Lias shales is well shewn.

Section in railway cutting south of Tilton Station.

		Ft.	In.
Upper Lias Shales, in grass-grown slopes, about	...	30	0
Middle Lias: Marlstone Rock—			
(*h.*) Bluish-green calcareous ironstone, massively bedded with an irregular flakey capping containing Nautilus truncatus, Ammonites acutus (in great numbers), A. spinatus, A. communis, A Holandrei, A. serpentinus, A. annulatus, A. Cœcilia, Belemnites elongatus, B. paxillosus, B. apicicurvatus, Lima pectinoides, Pecten æquivalvis, Cerithium ferreum, C. confusum, C. reticulatum, Eucyclus Gaudryanus, Phasianella turbinata, Trochus ariel, T. æolus, Cryptænia expansa, Plicatula spinosa, Rhynchonella tetraedra var. Northamptonensis, Terebratula punctata, and var. and occasionally fragments of fossil wood ... ... 0 6 to 0 9 passing down into dark bluish-green calcareous ironstone finely oolitic, containing Am. communis, A. acutus, Pecten lunularis, P. æquivalvis, Terebratula punctata, Belemnites 2 8		3	2
(*g.*) Grey finely oolitic calcareous ironstone, Pecten lunularis, Belemnites		1	7
(*f.*) Encrinital bed, grey finely oolitic rock, obliquely laminated with encrinital fragments, Belemnites 0 6		1	0
(*e.*) Bluish-green oolitic rock, with irregular seams of encrinital fragments, Belemnites ...		1	2
(*d.*) Bluish-green finely oolitic rock, with encrinite fragments, Pecten lunularis, P. æquivalvis		2	0
(*c.*) Bluish-green rock, becomes locally a "jack," Pecten æquivalvis, Belemnites, Rhynchonella tetraedra, Terebratula punctata		1	6

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(*b.*) Greenish arenaceous rock, locally a "jack" in upper portion, Belemnites, Terebratula punctata, and Rhynchonella tetraedra. The lower portion of this bed is nodular and veined with calcite	4	6
(*a.*) Greenish arenaceous rock, with "jack" in upper half; the lowest six inches contain many phosphatic nodules, Gresslya lunulata, G. intermedia, Pleuromya sp. Rhynchonella tetraedra, and Terebratula punctata... ...	3	6
	18	5
Middle Lias: Shales—with bands of sandstone and scattered limestone nodules ... (exposed)	13	0

The dip is here very well shewn. It is about 1° in a S.E. direction.

NOTE.—The Marlstone Rock is traversed by numerous joints. Along these fissures as also along the bedding planes the iron carbonate has, to the depth of a few inches on either side, become converted into the hydrated oxide, causing the stone to assume a yellowish brown colour.

The uppermost stratum, or rather the top layer of this stratum is remarkable for the organic remains it contains. Of these, one of the Ammonites, A. acutus, is especially noticeable, for it occurs in great numbers and in all stages of growth, yet not a single individual has ever been found elsewhere in the district. In addition, we find several other Ammonites and some interesting little Gastropoda, as well as ordinary bivalves and Brachiopoda. This top bed, or at any rate the special fauna it contains, is extremely local, being, so far as I know, limited to Tilton. On the north side of Robin-a-Tiptoes there is a brickyard section which exposes the upper beds of the Marlstone Rock and its junction with the Upper Lias shales; but although this point is only half-a-mile from the Tilton section we see no trace of the A. acutus bed.*

* A somewhat similar fossiliferous bed, containing some Upper Lias forms, has been noticed at the top of the Marlstone of Oxfordshire by Mr. Beesley, of Banbury, and is considered by him to be a passage bed to the Upper Lias. The A. acutus band at Tilton, however, although it contains certain Upper Lias forms, cannot properly be considered a passage bed.

(To be continued.)

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ON "THE NERVOUS SYSTEM OF VEGETABLES.—DO PLANTS FEEL?"*

BY F. T. MOTT, F.R.G.S.

It is well known that many plants possess, in some of their organs and tissues, a certain irritability by which various functional movements are set up and regulated. The folding leaves of sensitive plants, of which there are many; the sleep of plants, the twisting petioles and tendrils of climbers, the fly-traps of Drosera and Dionæa, the sensitive anthers of the Barberry, are familiar examples of this irritability which induces motion. But how is the motion produced? and what is the fundamental cause concealed under the term "irritability"?

These movements, which are all curvilinear, and represent the bending of some organ to one side, may arise either from the contraction of tissue on the inner side or from its expansion on the outer side. In the common sensitive-plant it is believed by Sachs that the leaf movements are caused by a sudden rush of liquid from the cells on one side of the articulation to those of the other side, which become at once turgid and enlarged, and bend the leaf over towards the empty cells. But in curving stems and tendrils Asa Gray has shown that if a slice is cut off the convex side, so as to make it thinner, the bending is more rapid, which shows that it is due to the contractions of cells on the inner side, not to the expansion of those on the outer.

Here, then, is something approaching to true contractile tissue, that tissue which constitutes the active muscles in the higher animals. But such animal muscle contracts only at the bidding of some delicate nerve fibre, and no such fibre has anywhere been found in the Vegetable Kingdom.

There are, however, among the lowest orders of animal life many examples of a contractile tissue which operates in the same manner as the muscles of the higher animals, and yet is not controlled by any discoverable system of nerve fibres. The Amæba has no nerves, yet it moves about apparently at its own will. The Medusæ swim by contractions of the gelatinous bell, and according to Mr. G. J. Romanes irritation is conveyed from side to side of this bell, yet no trace of nerve fibre can be found in it.

Surely, then, we may be justified in attributing the contraction of vegetable tissue to a power the same as, or

* Transactions of Section D of the Leicester Literary and Philosophical Society. Read June 20th, 1883.

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analogous to, that which contracts the tissue of the lower animals. What is this power?

In organic structures we may recognise four fundamental systems of tissue, viz.:—

The soft cellular tissue,

The hard bony tissue,

The contractile muscular tissue, and

The energy-conveying nerve tissue.

In the highest animals we find all those systems well developed. As we descend the scale we find them fading out in the order in which I have placed them. First the nerve tissue diminishes, then the muscular, then the bony, till the lowest organic forms consist of soft cells only.

But since, according to the laws of organic Evolution, the highest forms have been developed from the lowest, the capacity for this development must exist in those lowest forms, in the same manner as the capacity to develop into an oak exists in the acorn. In fact, the first embryonic form, even of man himself, is still a single cell.

Now in the Vegetable Kingdom we find that the first two systems of tissue are well developed, the cellular and the bony. The third system—that of the laminated and contractile muscle, is imperfectly represented by the foliage which clothes the hard skeleton and with which most of the contractile movements are connected; but the last and highest system, that of nerve tissue, is quite undeveloped.

The laws of true analogy, however, suggest the immense probability that this is only one of the regular phenomena of organic development; that the form of vital energy which constitutes thought and sentiment in man and which represents itself in the material world by nerve tissue, exists throughout the descending scale of life in a gradually less developed condition till in the Protozoa and Radiata among animals, and in all vegetables, it is so completely embryonic that it is not represented to our senses by any differentiated tissue.

From this point of view irritability in plants is seen to have precisely the same origin as in animals.

It is a nervous phenomenon; the result of nerve energy in its lowest form acting through contractile cells. In the most general sense the plant "feels" in the same way that the animal does, but probably in the most general sense only. No man can absolutely say what amount of *consciousness* of feeling may exist in any creature other than himself. But all the evidence we can gather points to the conclusion that consciousness is one of the highest conditions to which nerve energy attains, that it becomes continually less definite along the descending scale of life, and that in cellular animals and all plants there exists only a faint trace of it, or none.

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THE PRE-CARBONIFEROUS FLOOR OF THE MIDLANDS.

BY W. JEROME HARRISON, F.G.S.

(*Continued from page 40.*)

2.—*The Syenites of South Leicestershire.*—The little bosses of syenitic or dioritic rocks which crop out in South Leicestershire have been so recently described by me in the "Midland Naturalist,"* that I need not now allude to them in detail. They are largely worked for paving-setts, &c., at Enderby, Narborough, Croft, Stoney-Stanton-with-Sapcote, and Barrow Hill—little villages lying on either side of the railway from Nuneaton to Leicester. In most of the stone-pits the Keuper marls and sandstones are well exposed, resting upon the eroded surface of the igneous rock, and showing in a striking manner the difference between stratified and unstratified rocks. The microscopic character of the syenite proves it to be allied to the Charnwood rocks of the same character. At one point (the lower quarry at Enderby) the syenite is seen to break through a dull green slaty rock. This slate was assigned by the discoverers of the section (the Revs. E. Hill and T. G. Bonney) to the Charnwood series, but I believe that it is of later date, forming part of the Cambrian formation, which probably encircles Charnwood on all sides, although its junction with the older rocks is (in that district) everywhere covered over and concealed by newer strata.

But if Charnwood rocks themselves are not exposed in South Leicestershire these four or five low round-topped hills afford valuable evidence of an extension of the Pre-Carboniferous rocks for at least nine miles in a southerly direction.

3.—*The Pre-Cambrian and Cambrian Rocks of the Hartshill Range.*—Walking south-west from the hummocky rocks of Croft and Sapcote across the Triassic plain of South Leicestershire, we soon arrive at the foot of a well-defined ridge, which extends from Nuneaton, by Hartshill, to beyond Atherstone, a distance of six or eight miles. The rocks forming this ridge have a strike in strict accordance with its extension from north-west to south-east, and they dip to the south-west at high angles—from thirty to sixty degrees—rising abruptly from the Leicestershire plain on the one

* Vol. VII., pp. 7 and 41.

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hand, but gradually sloping to the higher surface of the Warwickshire coal-field which lies to the west and south. The altitude of the ridge is about 500ft., and from the road which runs along the crest the view extends to the blue hills of Charnwood, fifteen miles away, and westward—across the coal-field—to the bossy mass of Dost Hill. Examining the very base of the Hartshill Range, rocks of Pre-Cambrian age can be detected near the windmill at Caldecote. Here, in a little spinney between the mill and a large house, there is an old disused quarry in which a good section is exposed. The bulk of the rock is a dark basaltic-looking mass—possibly a diabase—which breaks across a very interesting rock—a quartz-felsite*—of which only a small portion is visible at the northern end of the quarry. This quartz-felsite much resembles similar rocks which occur in the Pre-Cambrian formation near Llanberis in North Wales. Below these rocks, in a kind of tunnel leading towards the house, we find volcanic grits and ashes comparable with those which are so common in Charnwood Forest. Altogether the Pre-Cambrians here form a narrow strip rather more than a mile in length, bounded to the east by a fault whose throw must be very great, since it brings the Keuper marls to a level with the Archæan strata.

The Quartzite of Hartshill.—Resting upon the volcanic rocks just described we find a considerable thickness of a metamorphosed sedimentary rock—a quartzite (once a sandstone) about 1,000 feet in thickness. Its base is a breccia, composed of small pebbles of the underlying rocks, but higher up it becomes exceedingly hard and compact. In the upper portion narrow bands of shale appear, which increase in number and thickness towards the top. The strike of the quartzite strictly accords with the direction of the ridge which is composed of it, being from north-west to south-east (parallel to the Charnwood axis), while the dip is to the south-west at an average angle of 35 degrees. The rock is extensively worked for road-metal, and is exposed in the quarries in a series of magnificent sections, all the way from Nuneaton to Hartshill. Its colour varies from white to red; although fossils have been diligently searched for, not a trace of one has as yet been discovered. Two dykes of diorite traverse the quartzite nearly parallel to its strike. One is well seen on either side of the Midland Station at Nuneaton; the other, which is much thinner, is exposed in the quarries close to Hartshill. The geological age of the quartzite is a

* Mr. T. H. Waller has kindly promised to examine these rocks microscopically, and to report upon them in an early number of the *Midland Naturalist*.

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difficult question, and its consideration will be better deferred till the mode of occurrence of the same rock in other localities has been described.

The Stockingford Shales.—Resting upon the quartzite, and forming a region of rugged ground which lies to the west of the Hartshill range, we find a considerable thickness—nearly 2,000 feet—of rubbly shales or mud-stones, which may be called the Stockingford Shales, because they are well exposed in the railway cutting of the Midland line between Stockingford and Nuneaton. At the base—where they rest upon the quartzite—these Cambrian shales vary from red to purple in colour, but higher up they are more commonly grey or black. Nodules of manganese—formerly worked in several little pits—occur in the red shales. The general dip of these beds is to the south-west, at angles of from thirty to as much as seventy degrees. Lying parallel to the quartzite, the shales occupy a much larger area, extending from beyond Atherstone in the north to Marston Jabet in the south, a distance of more than ten miles; while they occupy a surface-strip whose breadth varies from half a mile to rather more than a mile. At each extremity of this strip the beds roll over and assume an easterly dip, which is well seen in the old quarry near the Hall at Marston Jabet; and which is also indicated by the corresponding anticlinal of the coal measures north of Atherstone. Thus the structure of the country is that of an anticlinal, broken through by a great fault about the centre (near Hartshill), but preserving its crest to the north and south of this point of maximum dislocation. The shales are traversed by several dykes or intrusive sheets of diorite (well described by Mr. S. Allport *) which run more or less parallel to the strike of the shales. Here and there the dioritic rock thickens out into a boss, such as the great mass which is quarried near Oldbury Hall. Further south a fine section showing four dykes, traversing and sending out tongues into the shales, can be seen in the railway cutting at Chilvers Coton.

Owing to the difference in hardness between the diorites and the shales, steep ravines have been eroded in the latter; these form a striking feature in the scenery round Hartshill.

In the Stockingford cutting red shales are seen at the Nuneaton end, and these are overlaid by purple, grey, and black shales which undulate considerably, but whose average dip is at a high angle to the west. The only fossil I obtained here was an *Obolella*. At Camp Hill the red basement shales are

* Quarterly Journal Geological Society, Vol. XXXV., p. 637.

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exposed, and there are numerous other exposures along the general line of outcrop, all of which have the same character. Where the diorite crosses the sedimentary rocks the latter are much altered, being baked, bleached, and shattered. Fossils of certain genera are fairly numerous, although imperfect; but the species are few. They include the trilobite *Agnostus* (probably *A. pisiformis*), and a small *Lingulella* which is very like *L. ferruginea*. Professor Lapworth has also identified *Lingulella Nicholsoni*, *Obolella Salteri*, *Kutorgina cingulata*, and *Acrotreta socialis*. These are undoubtedly Cambrian species, but they are hardly sufficient to enable us to refer the Stockingford shales to a precise horizon in the Cambrian formation. Taking all points into consideration, however, we may, perhaps, assign these shaly beds to the period of the Upper Lingula Flags and Tremadoc Slates, in which the same general assemblage of fossils occurs. The Stockingford shales are separated from the coal-measures by a considerable fault which runs curving along the strike. It is marked by a line of brick pits, in which the rubbed-up material or "fault-stuff" is worked, and its effects are well seen in the deep pit in coal-measure binds and sandstones about a quarter-mile east of Stockingford station. All the diorite dykes end abruptly along this line of fault, showing that the period of their intrusion into the Cambrian shales was Pre-Carboniferous.

4.—*The Cambrian Rocks of Dosthill.*—The western boundary of the Warwickshire coal-field is, like the eastern, marked by the appearance of Cambrian rocks which have been brought to the level of beds of much more recent geological age, by the agency of faults running parallel to the strike of the strata.

Dosthill is a low eminence, four miles south of Tamworth, and not far from the Kingsbury Station of the Birmingham and Derby Railway. It owes its present elevation to igneous rocks of two or three varieties—mainly diorite—which traverse Cambrian shales. On the west of the hill, which rises precipitously from the course of the River Tame, a line of fault runs, by which the Triassic strata are placed on a level with the Cambrian shales, while on the eastern side a parallel fault of less "throw" places the coal-measures in a similar position; the latter rocks are well exposed along the railway, and a line of collieries marks the outcrop of the coal-seams, which in some cases are worked from their outcrop almost vertically, so greatly have they been bent up by the elevating action to which the central slice of Cambrian strata — sandwiched between Carboniferous and Trias—owes its position.

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The Dosthill Shales are remarkable for the abundance of worm-tracks which they contain. In a small field-pit, quite close to the main road, at the southern extremity of the hill, there is a good exposure of these "annelidean" shales, through which a neck or pipe of igneous rock is seen to rise, spreading out above into a horizontal sheet. Altogether the Cambrians of Dosthill occupy but a small area—less than a square mile. I have not detected the quartzite *in situ* here, but it is probably at no great depth, as large loose blocks lie upon the surface, brought up, it may be, along the line of fault.

It would thus appear that the floor of the Warwickshire coal-field is composed of Cambrian rocks, the Silurian and Devonian strata being absent. This is confirmed by the Leicestershire borings to which we shall presently allude.

A note as to the discovery of the true age of the Pre-Carboniferous rocks of Warwickshire may not be out of place here. In February, 1882, I read a paper* before the Philosophical Society of Birmingham, in which it was insisted that the hard rocks that occur as pebbles in the Permian, Bunter, and Keuper strata of the Midlands were derived—not from Wales and Scotland as Professors Ramsay and Hull had asserted—but from old rocks which formerly stretched more or less continuously right across Central England, and of which patches still existed at the surface. This paper, and the discussion which followed it, led to the announcement a few weeks later by Mr. F. T. S. Houghton and Professor Lapworth of the distinction between the Llandovery sandstone and the Cambrian quartzite of the Lickey Hills. By this time I had myself examined the Lickey Hills and I was at once struck with the resemblance between the true quartzite, which forms the greater part of the ridge, and specimens of the Hartshill quartzite which my students had brought to me when I was curator of the Leicester Museum. This Hartshill rock had been mapped as "altered Millstone Grit," by the officers of the Geological Survey.

I found that my doubts as to the correctness of the Survey classification were shared by Professor Lapworth, and in May, 1882, we paid our first visit to Nuneaton. A glance at the quartzite there was almost sufficient to prove its identity with that of the Lickey, so exact was the petrological agreement. Within the next few days we found the Pre-Cambrians below the quartzite at Caldicote, and the fossiliferous Cambrian shales both at Stockingford and Dosthill.

(To be continued.)

* On the Quartzite Pebbles contained in the Drift, and in the Triassic strata of England, and on their derivation from an ancient Land Barrier in Central England. Proc. Phil. Soc., Vol. III., p. 157.

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LIFE HISTORY OF A FILIFORM ALGA (*ŒDOGONIUM*).*

BY M. C. COOKE, M.A., A.L.S.

The subject selected for a short communication this evening is a somewhat commonplace one, and also one on which I do not pretend to have anything novel or sensational to say. All that I have set myself to do is to go over the history of a single species of Filamentous Algæ such as is found in our ponds and ditches.

At first I proposed to myself to give a general summary of Fresh-water Algæ, but being convinced by experience that generalisation is a most unsatisfactory process both to speaker and hearers, I resolved to limit my illustrations as much as possible to one species, leaving that to stand as a type of the Thread-like Algæ; merely reminding you that other species and other genera, or families, will differ more or less, in different directions, even as one family of flowering plants differs from another.

The object which I have in view may be briefly stated at the outset, and thus we shall come to understand each other, and perhaps avoid disappointment at the close. That object is simply to call your serious attention to those little-known aquatic plants which we call Fresh-water Algæ, and, if possible, give you a sufficient interest in them to stimulate enquiry and, it may be, awaken a desire to learn something more. There is a notion which some people possess, that everything outside their own particular circle of knowledge is unworthy of their attention. This is at best a foolish notion, and I may take it for granted that your presence here to-night exonerates you from any participation in it. If I should err in treating the subject in too elementary a manner, I beg that you will not imagine that I deem it necessary for your sakes to follow such a course, but that I am trusting to your indulgence, for the sake of those outsiders who may read my remarks, in the hope of obtaining some information.

I was out one early day in the summer on an excursion near the confines of Epping Forest, together with some kindred spirits, hunting in ponds and pools for living objects to furnish material for work with the microscope. There are still numerous small pools or ponds left in that neighbourhood,

* Transactions of the Birmingham Natural History and Microscopical Society. Read October 21st, 1884.

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although the hand of man is ever doing its best to improve them off the face of the earth. Instead of leaving us Nature unadorned, as we love to see her, public corporations always want to do too much, and convert our Epping Forests or Sutton Parks into ornamental tea gardens.

Some dead rushes were bent down near the edge of the pool, and totally immersed in the water. The naked eye was quite sufficient to discern that these rushes were covered with slender delicate filaments which floated out for half an inch into the surrounding water, almost of the colour of whitey-brown paper. Several of the most promising rushes were drawn out of the water, cut into short lengths, and placed in a glass tube, carefully corked, and transferred to the pocket. It matters not what else was collected during the day, since it is only of these delicate floating filaments found attached to the dead rushes that I desire to speak. It may be taken for granted that they were the filaments of a filamentous, or thread-like Water Alga, growing attached to dead plants. All that we would learn of them beyond this must be discovered by the use of the microscope.

I will not detain you with any details of manipulation; suffice it to say that a little of this floating mass, taken off on the point of a sharp penknife, was placed in a drop of water, and submitted to inspection under a quarter of an inch objective. The first glance was sufficient to show that it was a species of the genus *Œdogonium*. But why? I will endeavour to explain.

In the first place all the threads are discovered to be simple, without branches of any kind from the base to the apex, and these threads parted off by transverse partitions or septa at regular distances throughout their entire length. We will call these joints, or the intermediate space between any two of the partitions, a cell. These threads are made up, then, of a series of elongated cylindrical cells, attached end to end, so as to form a filament, it may be half an inch in length. Each of these cells contains within it a granular matter, at one time wholly green, but now partially discoloured, which we will call the cell contents. Looking again carefully at the membrane which constitutes the wall or boundary of these cells, we soon observe that some of the cells have delicate parallel lines or striæ crossing them near the top, and some of the cells have none. Whatever these lines may be, and we shall endeavour to discover their meaning presently, it is due to their presence that we have been able to affirm at once that this Alga is a species of *Œdogonium*.

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In many genera of Confervoid Algæ, and indeed in most, vegetation goes on at the apex, so that the basal cells are the oldest, and the terminal cells the youngest; the thread being increased in length by continued growth and subdivision of the terminal cell, but in *Œdogonium* this is not the case, since the intermediate cells possess the power of dividing and increasing by interposing a new cell, hence old and new cells will alternate. When a cell has reached maturity, and is about to divide, a little circular line is seen near its upper end. Gradually this line widens, and then it is seen that the wall of the mother cell has divided all round, and the cell above it is being slowly raised by the growth of a new cell, a daughter cell, arising, as it were, out of the apex of the mother cell, and carrying upwards the first streak, or cap, which was left by the breaking away of the wall of the mother cell. In this manner the new cell soon attains a length equal to that of the mother cell from whence it sprung. This accounts for the single line, which crosses just below the apex of some of the cells. When this young cell is matured it becomes in turn a mother cell, the splitting round is repeated, a second streak or line is formed just below the first, indicating that a second cap is being carried upwards, and so on until as many as four, five, or six striæ or caps are formed, which indicate that four, five, or six cells have been successively formed, the last one carrying up on its apex, one within the other, all the caps left by the circumscissile division of each successive cell, the number of caps or striæ corresponding to the number of cells produced consecutively immediately beneath the caps. By careful observation it will be seen that the youngest cells are narrower than the parent cells by the thickness of the cell wall.

Thus much, then, for the vegetative growth of the filament which accounts for the striæ at the apices of many of the cells.

(To be continued.)

DR. J. GWYN JEFFREYS.

On the 24th of January last there passed away, after a long and active life, the veteran conchologist, Dr. J. Gwyn Jeffreys. He belonged to a school of bygone scientists, whose honoured names live in the remembrance of the present generation by their works—beautiful alike in matter and production—and of daily reference by the student and worker. Retiring from the Bar about 1857, he was enabled to follow up his favourite pursuit of science, which he did with unflagging vigour until the day before he was seized with the illness which terminated his active and honourable career.

It would be a task outside the scope of this short notice—dictated, as it is, by a feeling of regard for the late Doctor—to enumerate the

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many valuable essays and papers published by him; they are known to most students of conchology; his largest and most popular work, "British Conchology," in five volumes, is the standard work of our time on the subject.

Dr. Gwyn Jeffreys was a great dredger. From 1861 to 1868 he explored the Northern seas in the "Osprey," his own boat; betweentimes visiting the Channel Isles, S. W. Ireland, &c. In 1869, in the "Porcupine," under the auspices of the British Government, and in charge of the expedition, he explored the West coast of Ireland; in 1870, the great depths of the Southern coasts of Europe were explored; in 1876, in the "Valorous" (going out with the Arctic Expedition as far as Baffin's Bay), he dredged in Davis' Strait and the North Atlantic; in 1880, by invitation of the French Government, he was with the Gallic savants dredging the depths of the Bay of Biscay; in 1878-9, he accompanied the well-known naturalist, the Rev. Merle Norman (often before a fellow-worker) to Norway, for dredging the fiords. He was well known to every *locum tenens* dignified by the name "naturalist" of the best collecting grounds on our own coast. "Why, bless your life, sir," said one of these worthies to us years ago, "I've took Forbes and Jeffreys and Thomson and lots o' them gentlemen, many's the time, out for days an' days together." What further passport to oracular belief need he advance!

Had the lamented Doctor been spared "yet a little while" he would have added still further to our knowledge, as some of his intended work remains awaiting the "touch of a vanished hand." An excellent trait in him was his kind and ever ready help to all who sought it in the elucidation of problems or the identification of species, as will be testified by a large circle of amateurs. The writer is rich in many letters from him. He was always punctual in reply, never sparing himself, but giving the benefit of his large and varied experience ungrudgingly.

It is a matter of regret to us that his great and valuable collection of typical and representative forms has gone to America. Worthy and noble supporter of science, ungrudging and liberal in its cause, an example to nations—we only regret our loss; we do not envy you your gain.

Dr. Gwyn Jeffreys took an active part in the work of the British Association, supporting the resolutions recommending its last, and coming, meetings in Birmingham.

Dying at the ripe age of seventy-six—what a revolution has taken place since, at the early age of nineteen, he contributed his "Synopsis of the Pneumonobranchous Mollusca of Great Britain" to the pages of the Linnean Transactions. With many other of the older naturalists he did not take kindly to the new doctrine, whose trumpet blast "shook the walls of the ancient Jericho," though, if he did not all accept it, he never actively opposed it. We do not carp; those who make the bricks build, and the temple of knowledge has been raised by many and varied hands. The builders have happily "wrought with anxious care," according to the "light which was in them."

G. S. T.

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THE FLORA OF WARWICKSHIRE.

AN ACCOUNT OF THE FLOWERING PLANTS AND FERNS OF THE COUNTY OF WARWICK.

BY JAMES E. BAGNALL, A.L.S.

(Continued from page 54.)

GRAMINA *(continued)*.

ARRHENATHERUM.

A. avenaceum, *Beauv. False Oat Grass.*

Native: On banks, roadsides, and in cultivated ground and pastures. Common. June to August. Area general.

b. nodosum. Rare or overlooked.

II. Occasionally in marly land about Warwick, *H. B.*
I have never seen this variety anywhere in the county.

HOLCUS.

H. mollis, *Linn. Creeping Soft Grass.*
Native: On banks, roadsides, and damp shady woods. Locally common. July, August. Area general.

H. lanatus, *Linn. Meadow Soft Grass. Yorkshire Fog.*
Native: In pastures, meadows, on banks, roadsides, and heathy lands. Very common. June to September. Area general.

TRIODIA.

T. decumbens, *Beauv. Decumbent Heath Grass.*

Native: On heaths, heathy roadsides, and sandy meadows. Local. June, July.

I. Sutton Park; Middleton Heath; Coleshill Heath, over a wide area; Marston Green; meadows near Ansley Hall; meadows near Berkswell Hall; roadsides near Balsall Street; Forshaw Heath.

II. *(Poa decumbens.)* Footway from Alcester to Wetherly, *Purt.*, i., 81. Beausale Common; Haywoods! *Y. and B.* Kenilworth Heath! Honily, *H. B.* Tachbrook Pastures; near Umberslade Hall; near Wilmcote; Austey Wood, Wootton Wawen; Stoke Heath, near Coventry.

KOELERIA.

K. cristata, *Pers. Crested Hair Grass.*

Native: In old pastures and on grassy roadsides, in marly and calcareous soils. Very local. June, July.

I. Footbridge, Bradnock's Marsh. June, 1882.

II. Tachbrook! *Y. and B.* Pastures near Ashorn! *H. B.* Honington; Tredington, *Newb.* Marly field, near Oversley Wood; bridle road from Billesley to Wilmcote; Bardon Hill; pastures and roadsides near Chesterton Wood; roadsides near Prince Thorpe.

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MOLINIA.

M. cœrulea, *Moench. Purple Hair Grass.*

Native: In bogs and damp woods and on moist heath lands. Local. August.

I. (Melica cœrulea) Coleshill Bog! Purt., i., 75; Sutton Park; Trickley Coppice, Middleton; Bentley Park; Coleshill Heath; Arley Wood; Marston Green; Bradnock's Marsh; Olton Reservoir; Bentley Heath, near Solihull; Forshaw Heath, near Tanworth; Windmill Naps, near Little Ladbrook.

II. Rounshill Lane! *Y. and B.;* Frankton Wood, *R.S.R.*, 1878; Alveston Pastures; All Oaks Wood, Cathiron Lane.

MELICA.

M. uniflora, *Linn. Wood Melic Grass.*

Native: In woods and shady lanes in marly soils. Locally abundant. May, June.

I. Pool Hollies Wood, Sutton Park; lanes about Oldbury and Hartshill; Edge Hill and Kingsbury Woods; lanes near Arley; Shustoke; Maxtoke; Coleshill: Kenwalsey; Fillongley; Corley Moor; Holly-Berry End; Marston Green; Berkswell; Frogmore Wood, Fen End; Solihull; Packwood.

II. Oversley Lane! *Purt.*, i., 75; Yarningal! *Y. and B.;* Allesley! Coventry; *Bolton King;* Little Alne; Shelfield Green; Moreton Bagot; lane near Bush Wood, Lapworth; Green Hill Green, near Spernall; Out Hill, near Studley; Baddesley Clinton; Brandon.

CATABROSA.

C. aquatica, *Beauv. Water Whorl Grass.*

Native: On the margins of pools, ponds, and canals. Rather rare.

I. (*Aira aquatica.*) Edgbaston Pool, *With.*, ed. 4, 138; Sutton Park; near Polesworth; Tamworth; canals near Atherstone and Mancetter; Hartshill; small pool near Solihull Railway Station; near Brown's Wood, Sharman's Cross; Bradnock's Marsh.

II. (*Aira aquatica.*) Bidford, *Purt.*, i., 74; brook in Baly's Lammas, Warwick, *Perry Fl.*, 8; Kenilworth, *Y. and B.*; pond near Bilton, *R.S.R.*, 1867; old canal near Harborough Magna! *L. Cumming*; pond near Farnborough; canal near Wilmcote; canal, Sowe Waste and Ansty; canal, Longford; canal near Preston Bagot, abundant; Pool Green Hill Green, near Spernal.

GLYCERIA.

G. fluitans, *Brown. Floating Meadow Grass.*

Native: In pools, ponds, ditches, streams, and canals. Common. June to August. Area general.

b. pedicellata, Towns.

I. Ditches near Plant's Brook; small pond near Bradnock's Marsh.

II. Honington! *F. Townsend*; Tredington, *Newb.*; Rounshill Lane! *H. B.*; canal, Rowington; canal near Preston Bagot; canal, Tardebigge; canal, Sowe Waste; near Stoke.

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G. plicata, *Fries. Folded-leaved Meadow Grass.*

Native: Near pools, ponds, ditches, and canals. Local, but widely spread. June to August.

I. Small pond near Bradnock's Marsh; pool near Chesset's Green; Monkspath.

II. Myton! *H.B.;* Rowington; Kingswood; canal near Tardebigge; wayside drain, Brinklow; canal, Sowe Waste; pool near Ansty.

Var. *subspicata.*

II. Fern Hill, *H.B.;* canal near Tardebigge.

G. aquatica, *Sm. Water Meadow Grass.*

Native: In rivers, pools, and canals. Locally common. August, September.

I. Near Sutton; Plant's Brook; canal near Atherstone; river Anker, Tamworth; in the Blythe, near Packington; near Blythe Hall, Coleshill; Dukesbridge; River Blythe, near Stonebridge; Blythe Bridge, near Solihull; Olton Reservoir; canal, near Three Maypoles, Shirley Heath.

II. Honington, *Newb.;* Kineton, *Bolton King;* frequent in the Rivers Avon, Alne, and Arrow; canal, Rowington; Oversley; Bidford; canal, Longford; Sowe Waste and Ansty; near Birdingbury Wharf; near Long Itchington Wharf.

SCLEROCHLOA.

S. rigida, *Link (Poa.* Purt). *Hard Meadow Grass.*

Native: On wall tops, roofs, and sandy places. Rather rare. May to July.

II. Wall at Oversley Green Bridge, *Purt.*, i., 80; a very robust form is abundant at the foot of the bridge near Oversley, but not on the walls about there, 1880; Ufton, *Y. and B.;* walls, Fenny Compton; walls at Abbott's Salford; Binton Church; Temple Grafton; Exhall and near Stratford-on-Avon; old walls on the Edge Hills; in marly fields near the Golden Cross, Exhall; marly roadsides and banks, near Prince Thorpe.

POA.

P. annua, *Linn. Annual Meadow Grass.*

Native on roadsides, walls, and heath lands, pastures, &c. Flowers all the season, and is common throughout the county.

P. nemoralis, *Linn. Wood Meadow Grass.*

Native: In woods, copses, and on marly banks and wall tops. Locally abundant. June, July.

I. Plentiful in lanes between Shustoke and Arley; lanes about Maxstoke; fordrough in the lane from Water Orton to Minworth; near Sheldon Church; lane from Stonebridge to Meriden Marsh; near Bradnock's Marsh; Cornel's End; Henfield, near Knowle; Frogmore Wood, Fen End.

II. Bushy bank between Alcester and Arrow, *Purt.*, iii., 9; Woodloes; Milverton, *Y. and B.;* Ragley Wood; marly banks near Oversley Wood; lane near Wootton Wawen; between Berkswell and Tile Hill; lanes about Wyken, Ansty, Sowe and Stoke.

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b. angustifolia. More rare.

I. Coppice near Minworth.

II. Wall tops, Oversley Village; Oversley Wood; Ragley Wood.

P. compressa, *Linn. Flat-stemmed Meadow Grass.*

Native: On old walls, banks, ruins, and in cultivated land. Local. July.

I. Maxtoke Priory ruins; old walls near Fillongley Hall; banks near Oldbury Hall; cornfields near Cornels End; lane near Meriden Shafts; Waste Lane, Berkswell; old walls near Balsall Heath.

II. Chesterton! Tachbrook, *Y. and B.;* house tops about Harborough-Magna, *Rev. A. Blox;* on walls, Marl Cliff; Bidford; Oversley; Wilmcote; Bearley; in fields, Spernal Ash, and Great Alne; wall, Red Hill, near Alcester; on walls near Stratford-on-Avon; quarry near Little Lawford; pastures, Newbold-on-Avon.

b. polynoda, Parn.

II. Brick Hill Lane, Coventry, *T. K., Herb. Brit. Mus.;* railway cutting near Henley-in-Arden; old walls, Wootton Wawen; Binton; old walls, Shottery; Tredington Village.

P. pratensis, *Linn. Smooth Meadow Grass.*

Native: In fields, pastures, on banks, wall tops, &c. Very common. May, June. Area general.

Var. *b. angustifolia,* Gaud. Rare.

II. Marly banks near Prince Thorpe; banks near Moreton Bagot.

Var. *c. subcærulea,* Sm.

On heaths, heathy roadsides, and wall tops, more or less frequent throughout the county.

Var. *d. strigosa,* Gaud. Rare or overlooked.

II. On old walls near Bidford.

P. trivialis, *Linn. Rough Meadow Grass.*

Native: In woods, shady places, on banks, and in meadows, &c. Common. June, July. Area general.

Var.. *b. Köhleri,* DC. Very rare or overlooked.

II. Oversley Wood.

A very singular and marked variety of *P. trivialis,* having smaller flowers and more compact panicles than the type. A marked form of *P. trivialis* also occurs in sandy fields near Wilmcote; this I have not yet been able to assign to its proper place.

[*P. sudetica,* Haenke, is abundant and well established in a coppice near Leek Wootton (see Exchange Club Report, 1876), but is not more than an alien or casual weed.]

BRIZA.

B. media, *Linn. Common Quaking Grass.*

Native: In pastures, by roadsides, and rarely on damp heath lands. Rather local. July.

I. Sutton Park, on damp heath lands; roadsides near Penns; Birchley Heath; Water Orton; near Knowle and Solihull, &c.

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II. Chesterton! *Y. and B.;* near Henley-in-Arden; near Stratford-on-Avon; near Binton Bridges; Bardon Hill; Newbold-on-Avon.

CYNOSURUS.

C. cristatus, *Linn. Crested Dog's-tail Grass.*

Native: In meadows, pastures, by roadsides, &c. Very common. June, July. Area general.

Occasionally I have found it with proliferous spikes.

DACTYLIS.

D. glomerata, *Linn. Rough Cock's-foot Grass.*

Native: In meadows, pastures, and on roadsides and banks. Very common. June to September. Area general.

FESTUCA.

F. Pseudo-myurus, *Soyer. Mouse-tail Fescue Grass.*

Native: On wall tops and sandy roadsides. Rather rare. June, July.

I. Slade Lane, Witton, on sandy roadsides; on banks near Erdington.

II. Emscote, *H.B., Herb. Brit. Mus.;* Warwick, old walls! *Herb. Perry;* Milverton, *Y. and B.*

F. sciuroides, *Roth. Barren Fescue Grass.*

Native: In pastures, on grassy roadsides, and on walls. Locally common. May, June.

I. Sutton Park; Middleton Heath; Coleshill Heath; lanes near Hampton-in-Arden; Solihull, &c.

II. *(Festuca bromoides)* King's Coughton; Coughton Court! *Purt.*, i., 83; Kenilworth, *Y. and B.;* Honington, *Newb.;* near Oversley; in hilly pastures near Great Alne.

F. ovina, *Linn. Sheep's Fescue Grass.*

Native: On heaths, heathy roadsides, and woods. Locally abundant. June, July.

I. Sutton Park, on the common land near Four Oaks; Middleton Heath; Baddesley Common; Bannersley, near Coleshill; Coleshill Heath: Bentley Heath, &c.

II. Milverton, *Y. and B.;* Armscote, *Newb.*

b. tenuifolia, Sibth. Local and rare.

I. Hilly pastures near Gravelly Hill Station; very abundant on heaths and in woods at Sutton Park; near Middleton Hall; Middleton Heath; Spinney, near Bannersley Rough; Baddesley Common; Marston Green; Earl's Wood; Balsall Common; Forshaw Heath.

II. Armscote, *Newb.*

F. rubra, *Linn. Linn. Sm. Hard Fescue Grass.*

Native: In damp pastures, and on sandy banks and roadsides. Very common. June, July. Area general.

A very variable grass both as to its habit of growth and colour, many of the forms being so distinct as to be at once recognised, and the varieties require, I think, more careful investigation than I have been able to bestow upon them.

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Var. *fallax*. Rare.

I. Earlswood Reservoir, 1883; canal siding near Hockley.

This was named for me by Prof. Haekel, of St. Poelton, and will, I think, be found more common than now appears when better known.

Var. *longi-aristata*, Haekel, *M.S.*

This was sent to Prof. Haekel in 1882 and was considered by him to be new as a variety; it grew fairly abundant near Combe Abbey in 1880, but I could not find it again this year, so that it may be, as since suggested by Prof. Haekel, an accidental form. It is noticeable for the very long awn, longer even than the flowering glumes.

F. elatior, *Linn. Tall Fescue Grass.*

Native: On roadsides and near canals in marly soils. Local and rare. June, July.

I. Near Witton Reservoir; near Olton Pool; rare in the Tame basin.

II. Itchington Holt! *Y. and B.;* Honington; Tredington; Shipston, *Newb.;* Little Lawford, *H. W. T.;* Marl Cliff; Binton, Redhill; roadsides between Redhill and Stratford-on-Avon; canal banks near Wilmcote and near Rowington; Cathiron Lane and canal siding near Brinklow.

Two forms occur in the county, one of them being very near the variety *b. arundinacea*, but scarcely agreeing with the maritime forms of that variety.

F. pratensis, *Huds. Meadow Fescue Grass.*

Native: In meadows, damp pastures, and on roadsides. Common. June, July. Area general.

b. loliacea, Huds. Rare.

I. Roadsides near Moor Hall, near Sutton; near Oldbury Hall; damp meadows Blythe Bridge, near Solihull.

II. Shut Lane, Coventry, T.K., *Herb. Perry;* Myton, *Y. and B.*

F. gigantea, *Vill. Tall Fescue Grass.*

Native: In woods, copses, and on shady banks. Locally common. July to September.

I. Middleton Woods; Heathland, near Tamworth; Hartshill Hayes; Bentley Park; near Arley Railway Station; Dukesbridge, near Coleshill; lane to Hams Hall from Curdworth Bridge; Olton Pool; Shelly Lane, near Solihull; wood near Berkswell Hall; woods near Earlswood.

II. Wixford Lane, *Purt.*, i., 77; Tachbrook, *Y. and B.;* Honington; Tredington; Shipston-on-Stour, *Newb.;* Alveston Pastures Wood; Oversley Wood; Bearley and Snitterfield Pastures; Stooper's Wood, near Wootton Wawen; in several of the lanes from Lapworth Street to Kingswood; coppice in Quarry Lane, Wroxall; Oakley Wood; Cubbington Wood; Stoneleigh; Combe Woods.

b. triflora, Linn. Rare.

II. On marly banks in a lane from Great Alne to Alne Hills, abundant there. A mere form.

(To be continued.)

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METEOROLOGICAL NOTES.—January, 1885.

The barometer was high at the commencement of the month (30·392 inches), but fell slightly till the 5th, rising again to the 7th, after which it fell rapidly till the 11th (28·773 inches), and again rose till the 19th, falling again gradually till the end of the month. The weather was, for the most part, overcast and dull, with rarely a bright day. The temperature was variable, but at no period of the month very cold. The mean was, however, nearly 2 degrees below the average, and 7 degrees lower than that of January, 1884, but this is attributable to the low maxima, which were under 40 degrees on 16 days. The highest readings generally were on the 29th, and were as follows:—53·8° at Hodsock, 53·7° at Loughborough, 52·0° at Coston Rectory and Henley-in-Arden, and 50·8° at Strelley. 85·1° was registered in the rays of the sun at Loughborough on the 27th, and 76·4° at Hodsock on the 14th. The minimum readings were 18·6° at Hodsock on the 22nd, 19·0° at Coston Rectory on the 6th, 20·9° at Strelley on the 22nd and 23rd, 21·0° at Henley-in-Arden, and 21·4° at Loughborough on the 22nd. On the grass 15·0° was registered at Hodsock, and 15·7° at Loughborough on the 22nd; and 16·5° at Strelley on the 6th. The rainfall was decidedly below the average, and was confined to two periods—at the middle and end of the month. The total values were 2·03 inches at Strelley, 2·08 inches at Henley-in-Arden, 1·61 inches at Coston and Loughborough, and 1·42 inches at Hodsock. The heaviest fall generally was on the 10th, and the number of "rainy" days varied from 18 to 23. Snow, in small quantities, fell on the 12th, 13th, 14th, and 17th. Sunshine was very deficient. Lunar halos were seen at Loughborough on the 25th and 27th. Lightning was observed at Coston Rectory on the 10th.

Wm. Berridge, F.R. Met. Soc.
12, Victoria Street, Loughborough.

Natural History Notes.

MM. Fremy and Urbain on the 5th of January brought before the Académie des Sciences their "Chemical Study of the Skeleton of Plants." They drew attention to cutose, the substance which covers and protects the aërial organs of plants, and is shown to approach the fatty bodies in its properties and composition. Cutose resists the action of energetic acids, it is insoluble in dilute alkalies, neutral solvents have no action upon it, but boiling alkaline liquids modify its conditions. This paper opens out a new field of enquiry.

Abnormal Inflorescence of the Hazel.—My friend Mr. Frederick Enock, of Woking, has recently sent me a very interesting example of what appears to be a "multiplication of axile organs" in the case of an abnormal state of the male inflorescence of the Hazel, *Corylus Avellana*. In this instance the branch is terminated by a truly cone-like head of catkins, about seventy in number. The catkins are immature, and their arrangement is quite symmetrical. An illustration of a somewhat similar instance is given in Dr. Masters' valuable "Vegetable Teratology," page 349, which will give a fair idea of this abnormality, except that the arrangement of the catkins in Mr. Enock's specimen is more regular. This abnormal condition is possibly due to an over-development of male buds, with an abnormal suppression of the internodes; the bracts are absent in this case. I have never before seen a like case, and think it must be a rare phenomenon.—J. E. Bagnall.

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Mr. Joseph Prestwich, Professor of Geology in the University of Oxford, has, by thirty-two votes out of fifty, been elected a corresponding member in mineralogy of the Académie des Sciences in the place of the late Quintino Sella.

M. A. Bechamp brought before the Académie des Sciences, on January 19th, a paper "On the Origin of the Microzymas and Vibrionians Everywhere." He argues against M. Pasteur that these germs are to be sought for originally in the ground and water, where they are deposited by the disintegration of the neozoic and palæozoic rocks and by decomposing animal and vegetable matter of all kinds.

Mr. Ferguson, of Kinmundy, read a paper before the Edinburgh Geological Society at the last meeting "On Certain Deposits of Graphite and Iron in Aberdeenshire." Details were given of veins of hæmatite iron and manganese which are very extensive, and many of the veins were found to be as rich as the Spanish ore. Plumbago is plentiful, the only question being its production and transport so as to be used economically.

Notes from Woking.—On April 13th, 1883, as recorded in the "Midland Naturalist," I found a large colony of the British Trap-door Spider, *Atypus piceus* (Sulzer), in this neighbourhood. Since that time I have found three other colonies, to all of which I have made very frequent tours of inspection, carefully noting down on the spot something relating to the habits and economy of this most interesting spider, whose life-history I shall be able to give in a few months hence. On December 30th, 1884, whilst examining one of the "tubes" or nests, I displaced some of the loose sand, causing it to fall down, when out crawled an Andrena, which, after shaking itself clean, tried to fly, but was quickly boxed, and before I had time to transfer it to my pocket, I saw a Nomada extricate itself from the loose sand, and it succeeded in flying a few inches before I captured it. The day had been beautifully fine and spring-like, though the night following was frosty. I transferred both bees to a large pot nearly full of sand, and, on examining next day, found both had buried themselves, the Nomada coming up again in a few days, remaining on the moss, except when the weather was warmer, when it became very active. I took it out on January 21st, and next day dug the Andrena out, which had burrowed down four inches deep. I sent both specimens to Mr. Ed. Saunders, who always is so kind in giving me the names of bees, &c. He identified them as male *Andrena nigrocænea* and female *Nomada alternata*. No doubt the exceedingly mild November had brought them forward more than three months before the usual time of their appearance.—Fred. Enock.

Lycopodium clavatum.—Mr. Enock has also sent me specimens of the Wolf's Claw, *Lycopodium clavatum*, from heath lands, near London, and the sight of this interesting plant recalled to my recollection the fact that it was first recorded as a British plant from Hampstead Heath by Gerarde in his "History of Plants," 1597. Some of the readers of this magazine may feel an interest in knowing what our old and quaint friend Gerarde had to say about this plant, for it is sometimes pleasant to hear what our predecessors of 300 years ago thought and said about objects which interest some of us who live in more enlightened times. Speaking of this plant, which he calls *Muscus clavatus, sive Lycopodium*, Club Mosse, or Wolfe Claw Mosse, he says, "There is likewise another sort of mosse, which I have not elsewhere found than upon Hampstead Heath, near unto a little cottage, grow-

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ing close upon the ground amongst bushes and brakes, which I have shewed unto divers surgeons of London, that have walked thither with me for their further knowledge in simples, who have gathered this kinde of mosse, whereof some have made them hat-bands, girdles, and also bands to tye such things as they had before gathered, for which purpose it most fitly served; some pieces whereof are six or eight feet long, consisting, as it were, of many hairie leaves set upon a tough string, very close couched and compact together, from which is also sent certain other branches like the first; in sundry places there be sent down fine little strings, which serve instead of roots, wherewith it is fastened to the upper part of the earth and taketh hold likewise upon such things as grow next unto it. There spring also from the branches bare and naked stalks, on which grow certaine ears as it were like the Katkins or blowings of the Hasell Tree; in shape, like a little club or the reede Mace, saving that it is much lesser, and of a yellowish white colour, very well resembling the claw of a wolfe, whereof it tooke his name; which knobby katkins are altogether barren bringing forthe neither seed nor floure." He also informs us, that "Being stamped and boyled in wine and applied, it mitigateth the paine of the gout. Floting wine, which is become slimie, is restored to his former goodness, if it be hanged in the vessel." Ger. Em., pp. 1562-4. The catkins which he mentions are the male flowers of the plant, and produce a great quantity of spores, the existence of which appears to have been unknown to him. Johnson, "Useful Plants of Great Britain," states that "The spores are collected in considerable quantities for the manufacture of fireworks, being so extremely inflammable that they burn with a kind of explosion when brought into contact with flame. This powder is likewise sold in the druggist's shops for preventing excoriation in young children, and for rolling pills in to prevent them sticking together. It is known as Lycopodium or Vegetable Sulphur, and under these names is imported in considerable quantity from the northern part of Europe, where it is more abundant than here." The medicinal properties of the plant have been extolled by our older writers, from Gerarde down to Dillenius, but the plant holds no place in the British Pharmacopœia. The spores of this plant are so repellent of moisture that if scattered over the surface of water in a basin a stone may be picked from the bottom without wetting the hand. Lightfoot, in his "Flora Scotica," says that "The Swedes make mats of the club moss to rub their feet on." Newman, in "The Phytologist," i, p. 5, seems to discredit this statement. He says, "If this be true, it is remarkable that the fact should have escaped the notice of such observant men as Linnæus and Wahlenberg." Mr. J. B. Stone, however, assures me that he saw such mats made of *Lycopodium clavatum* and offered for sale, during his last journey through Norway.—J. E. BAGNALL.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—GEOLOGICAL SECTION.—January 27th.—Mr. R. W. Chase in the chair. Mr. Chas. Elcock, of Belfast, exhibited seven type slides of foraminifera—two of fifty different species each, four of different species each, of different orders—*Miliolidæ*, *Hyaline*, *Porcellanous*, and *Lagena;* one of thirteen different species of the Arenaceous order;

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and several species of living foraminifera. ANNUAL MEETING, February 3rd.—Mr. T. H. Waller, B.A., B.Sc., presided. The twenty-sixth annual report of the committee, which was read by the Chairman, referred with pleasure to the very valuable work which had been done during the past year. It was with pleasure that the committee recorded the honour conferred upon Mr. J. E. Bagnall by his being elected an Associate of the Linnean Society in recognition of his valuable original work in the various branches of botanical science. He was one of the oldest members of that society, and had rendered to it most useful service, his papers on Bryology and his "Flora of Warwickshire" having gained for him a reputation far beyond his native town. At the end of 1883 the society numbered 300 members. The total number of members and associates was now 288, being a decrease of twelve. The reports of the proceedings of the different sections were also presented. The statement of accounts, which was read by the Treasurer (Mr. C. Pumphrey), showed an expenditure of £293 18s. 10½d. for the past year, and there was a sum of £60 owing to the treasurer. The deficiency, it was explained, was due to arrears of subscriptions. The election of officers for the ensuing year was then proceeded with. Mr. R. W. Chase was elected president, Mr. J. E. Bagnall and Professor Hillhouse vice-presidents, Mr. C. Pumphrey treasurer, Mr. W. B. Grove librarian, and Messrs. Morley and Wilkinson hon. secretaries. BIOLOGICAL SECTION.—February 10th. Mr. J. Morley in the chair. Mr. W. H. Wilkinson exhibited mounted specimens of *Batrachospermum moniliforme*, var. *Boltoni*, the new variety recently found by Mr. T. Bolton. Mr. J. E. Bagnall mosses, *Sclcropodium cæspitosum*, in fruit, from near Brinklow, very rare in fruit. For Mr. J. B. Stone, mosses, *Eurhynchium circinatum* and *Orthotrichum saxatile* from Tenby. For Mr. R. Rogers. *Pleuridium subulatum* and other mosses from Hampton-in-Arden. For Mr. Frederick Enock, *Lycopodium clavatum* (wolf's claw), and an abnormal condition of the male flowers of the common hazel, *Corylus Avellana*, in which a cone-like body was formed of about seventy-five of the catkins. Mr. R. W. Chase then gave his short notes upon *Panurus biarmicus* (bearded Tit), with specimens showing their life history, from observations made in Norfolk, illustrating his remarks by specimens in various stages, also nests and eggs. He stated that owing to the drainage of the fens the localities suitable to this beautiful species are annually becoming more limited, and afterwards described the nest, which is placed nearly on the ground amongst the reeds and other aquatic foliage, but not attached to them. Nidification commences about the first week in April, but owing to the demand for eggs the marshmen rarely allow the first clutches to hatch, consequently eggs can be taken as late as July. He concluded with a description of their habits, food, and internal construction. A discussion followed, in which Messrs. Wilkinson, Morley, France, Udall, Grove, Pumphrey, and Bagnall took part.

THE BIRMINGHAM MICROSCOPISTS AND NATURALISTS' UNION.—January 19th.—Mr. Moore exhibited specimens of Burying Beetle, *Necrophorus vespillo;* also gizzard of the same under the microscope. The following objects were also shown under microscopes:—Mr. Rodgers, a marine alga, *Ceramium strictum;* Mr. J. W. Neville, *Bicellaria ciliata* and *Catenicella margaritacea*, Australian polyzoa; Mr. Hawkes, calcareous granules from *Arion ater*. January 26th.—The President, Mr. Beale, exhibited a skull of Bottle-nosed Porpoise; Mr. Madison, *Terebratula caput-serpentis*, and other shells from Oban.

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Under the microscopes, Mr. Moore, specimens of wasp paper, showing in some pieces bands of scalariform tissue, and in others a utilisation of insect remains; Mr. J. W. Neville, *Flustra episcopalis*, from New Zealand; Mr. Rodgers, stellate hairs of Elæagnus; Mr. Hawkes, sponge spicules, *Muricea luniformis*; Mr. Grew, flea of Hedgehog, *Pulex erinacei*. February 2nd.—Mr. Moore showed under the microscope first and third leg of Honey Bee, with pollen brush and basket; Mr. J. W. Neville, larva of *Orgyia pudibunda*, mounted whole, popularly known as the Hop Dog. Mr. W. Tylar then read a paper, "Notes on the Hydra," which traced the early history of observations on this polype, and described the four kinds found in this country. The peculiarities of their structure were noticed at some length, with the various kinds of thread-cells, some so small as only to be seen with very high objectives; supposed muscular and nervous system; and the simplicity of their digestive organs. The paper also described their power of repairing injury and building up a complete polype from a small part, their various modes of reproduction, and the parasites frequenting them; and concluded by describing a ready method of killing them with their tentacles extended, and the most suitable medium for mounting them in. The paper was illustrated by diagrams and microscopic preparations. February 9th.—Mr. Hawkes exhibited a specimen of large Mussel and other shells from Peru; also specimens of silver ore. Under the microscopes Mr. Tylar showed crystals of oxalate of potash; Mr. Moore, pulmonary plates of Spider, stained; Mr. J. W. Neville, Oak Apple Fly, *Cynips terminalis;* Mr. Sanderson, spores of a New Zealand Fern, *Steichenia flabellata;* Mr. Hawkes, *Gamasus coleopterorum*. February 16th.—Mr. Moore exhibited a collection of Ichneumon Flies and their nests. Under the microscopes, Mr. Tylar, transverse section of Rat's tongue, injected, and *Hydra vulgaris* stained with osmic acid, showing filaments projecting from thread cells. Mr. J. A. Grew then read a paper, "Insect Tragedies," which pointed out that the classification of insects had received more attention than their habits, economy, and instincts, and described the predacious habits of many, both in the larval and imago stage; showing that from the number of their foes an extraordinary fecundity was a necessity against their extermination. The paper concluded by describing some uses of insects, certain protective disguises, and the necessity of Nature preserving a balance of power.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY.—Section D.—Zoology and Botany.—Chairman: F. T. Mott, F.R.G.S. Monthly Meeting, February 18th. Attendance, fourteen (five ladies). Exhibits: Fruit of a cucurbitaceous plant from Madeira, called "Chou-chou," used as a vegetable; specimen of the fresh-water shell *(Planorbis corneus)* from the Soar, near Leicester, by the Chairman; a parasitic mite from the common house-fly, mounted as a microscopic slide, by Mr. Grundy. Paper, by the Chairman, "On the weapons of animals," showing how carnivorous habits necessitate the use of weapons both of offence and defence; describing how nearly every external organ of the body has been modified for this purpose under various conditions of life; how a variety of special growths in the shape of horns, spurs, stings, &c., have also been developed in certain families; and how man, though the most widely spread and most omnivorous of large animals, is the most naturally defenceless, his superior brain power enabling him to provide artificial weapons and so to keep his limbs in the best condition for other uses.

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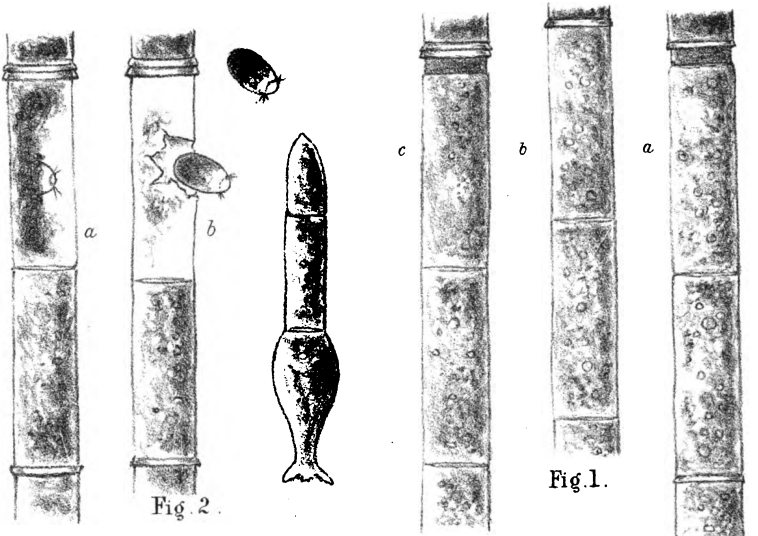
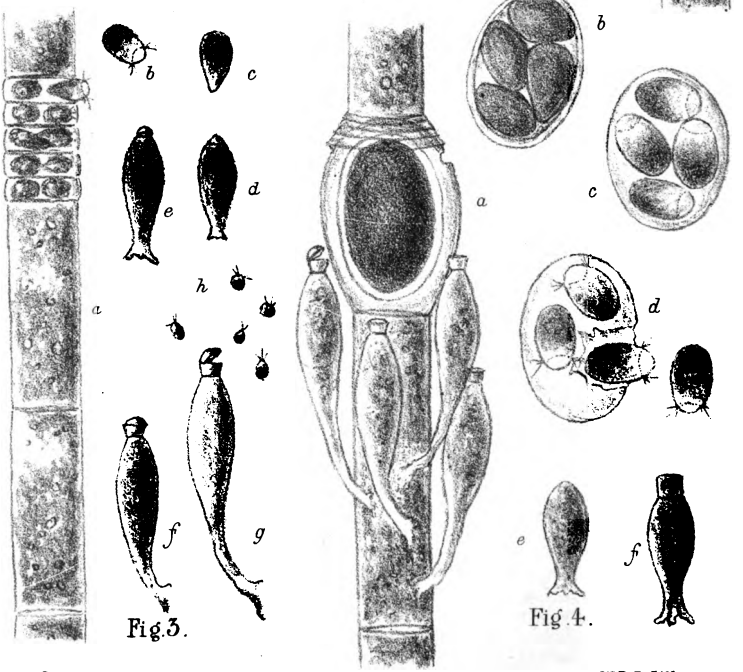
Plate III.





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ŒDOGONIUM CRASSIUSCULUM

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LIFE HISTORY OF A FILIFORM ALGA (*ŒDOGONIUM*).

BY M. C. COOKE, M.A., A.L.S.

(*Continued from page 76.*)

Having for the time disposed of the ordinary cells such as are observed in both the sterile and fertile condition of the plant, we now return to the microscope and look along the threads in search of any divergence from this ordinary condition of vegetative cells. And, supposing the threads to be in the fertile state in which we found them, we soon become conscious of the presence of certain special cells interspersed amongst the rest, which are broader, more oval, and contain within them not the granular cell contents, but a large, opaque, definite, somewhat globose body, of a dark colour, which we will call a spore. Its proper designation is oospore, or a spore produced in an ovarian sac, or cell, which sac, or cell, is termed the oogonium. The oogonium is a little larger than the oospore but of the same form, and the oospore lies free within it, being at first greenish and granular but at length invested with a brown coat, which again has an outer transparent layer more or less thick, according to the species. Concerning ourselves only with this one species of *Œdogonium*, we find it producing nearly elliptical brown oospores, with a very thick hyaline outer coat, hence called *crassiusculum*. One

PLATE III.

DESCRIPTION OF THE FIGURES.

Fig. 1.—Illustrations of the growth of new cells. At *a* it has just commenced, leaving a ring at the apex of the daughter cell; *b*, the daughter cell has attained an equal size to the mother cell; at *c* a second new cell has commenced, bearing the first and second ring at its apex. × 200.

Fig. 2.—Asexual reproduction; *a*, zoospore being formed in mother cell; *b*, zoospore escaping by rupture of the mother cell; *c*, germinating asexual zoospore. × 200.

Fig. 3.—*a*, androsporangia of *Œ. crassiusculum*; *b*, androspore; *c*, the same, with the cilia absorbed; *d*, *e*, *f*, *g*, successive stages in the development of dwarf males from the androspore; *h*, spermatia. × 200.

Fig. 4.—*a*, portion of filament of the Œdogonium, with oospore in the oogonium, and four dwarf males attached to the supporting cell; *b*, *c*, *d*, formation of four sexually produced zoospores from the fertilised oospore; *e*, zoospore at rest, and attached at its base; *f*, commencement of growth of the first cell of the young *Œdogonium*. × 200.

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thread may have several oogonia, although they are usually scattered over the filament, and not contiguous. The striæ, or caps, at the apex of the oogonium indicate that the oospore has been developed in one of the youngest cells. Near the top, or certainly above the middle of the oogonium, is a small hole perforated through the wall of the oogonium. It is through this opening only that any small body can find entrance to the enclosed oospore, and it is through this opening that fertilisation is effected.

Leaving the oogonia for a while, we will traverse with our eyes one of the filaments, to see if we can trace any other cell modification, and by careful observation we at length find from four to six short cells, not more than half as long as broad, lying together in one part of the filament towards the apex, the whole six short cells not occupying so much in length as any one of the vegetative cells. These short cells are the spore cells, or androsporangia, of the male organs. As there is no other similar mode of reproduction amongst Algæ, and this rather a complicated one, I must ask you to follow me into the details of the process.

I have said that these four, five, or six short cells in the filaments are destined to produce the male organs; the female, or oogonium, containing the oospore, or unfertilised egg, being seated in the same filament, lower down. When mature and the fulness of time is come, the outer wall of each of these short cells, or androsporangia, is ruptured, and about two zoospores of a peculiar kind called androspores make their escape. These are green oval bodies, paler at one end, where they are furnished with a fringe of movable cilia. By means of these cilia, the newly-escaped zoospores move about in the water actively for a time, apparently enjoying their freedom, until at length they grow more and more sluggish until finally they attach themselves by the paler end, and another change takes place. It must be remarked here, that when these zoospores escape from their androsporangia, on a roving commission, they evidently have a definite work to accomplish, although they appear to be only indulging in frivolous pastime, because when they settle down and attach themselves by their paler end and abandon all frivolity, they invariably fix themselves to the cell immediately beneath the oogonium. I will leave you to explain or moralise upon this fact as you please, but to me it is one of extreme suggestiveness, that two or three or half-a-dozen active little bodies, without sense or sensibility, or instinct, should quit their parent cells and travel down the filament, it may be for half its length, and then attach them-

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selves, not to any promiscuous cell which may be near them, but to the cell which immediately joins the oogonium, and not by mistake the cell above, but the cell below the oogonium, and there remain permanently fixed. What is the attraction powerful enough to draw them to this spot, and no other? "Surely there are more things in heaven and in earth than are dreamt of in your philosophy."

We have followed the androspores from their parent cell until they attach themselves to the cell immediately beneath the oogonium. When they have done so the base elongates into a kind of stem; the upper portion also grows and elongates until it assumes more or less a club-shaped form. The apex narrows into a mouth, covered with an operculum, or movable lid. Meanwhile active little spermatozoids are being formed in the interior, and the androspores are converted into little male plants (nannandres), clustered around the oogonium, ready at any moment for their spermatozoids to escape and enter the little opening in the wall of the oogonium to fertilise the oospore which it contains. Thus, then, we trace this process; the formation of an ovum or unfertilised spore in its ovarian sac or oogonium, and the same thread producing androspores (or spores of male plants) which escape and then attach themselves close beneath the oogonium, produce their own spermatozoids, which in fulness of time issue at the apex, by the falling off of a deciduous operculum, and immediately enter the aperture of the adjacent oogonium and fertilise the oospore. This work being accomplished, the male plants have no other mission in this world, therefore they dry up and wither away, whilst the oospore, now rendered fertile, passes through a period of rest and in due time produces a new generation.

From these fertilized oospores we may now follow the young plants until we reach the point at which our history commenced and the cycle is complete.

Before completing this history, we may make a diversion here to explain another method of reproduction which prevails in this interesting genus of aquatic plants. We have hitherto been watching a truly sexual reproduction in which male and female elements perform their part, but in this other method there is no visible evidence of sexuality; it is, as far as we can judge, a purely asexual or nonsexual reproduction, analogous to budding in higher plants.

In this method for the continuance of its species, any cell in an ordinary vegetative filament will serve. In one of these cells there is a turbulence in the cell contents, which at length, draw closer together, and in a short time an ovate body is

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formed similar in size and appearance to the androspores, from which the dwarf male plants are seen to be produced. This ovate body, nestling within its parent cell, is seen to be furnished near its paler apex with vibratile cilia. When mature, the enclosing cell is ruptured, and the imprisoned zoospore, endowed with active motion, makes its escape. In its movements through the water it seems impossible to distinguish this new zoospore from the zoospores, or androspores, of the short cells. Like them, it moves about for some time, then becomes sluggish, and ultimately comes to rest. The cilia are absorbed, and the pale end of the zoospore is attached to some object but not as in the previous instance to any special cell of the parent plant, nor in any proximity to the oogonium. Alike as they are in size, form, and movement, they are different in their origin and in their destiny.

When, at length, these asexually produced zoospores come to rest, they form at the base a kind of clasping radicle, or more or less lobed expansion, by means of which they attach themselves; then there follows a lengthening or expansion upwards, which in process of time is cut off by a septum from the basal cell, and becomes the first cell of a new plant, or rather the second, including the basal cell, which is persistent and remains through the whole life of the plant. Hence the basal cell in all perfect filaments of Œdogonium threads, whether proceeding from an asexual zoospore or the zoospores of a resting spore, is always more or less bulging, or clavate, with a spreading, discoid, or somewhat lobed base. It is unnecessary to follow the growth of this young plant into a filament, in all respects resembling its parent.

We now return to the fertilised resting spores from which we recently diverged. We will suppose that the old plant has decayed and nothing remains but these quiescent spores, which are now sunk to the bottom of the pond or nestling in the axils of some aquatic plant. In due time, but always after some period of rest, these spores exhibit evidences of vitality, at first by becoming more greenish in color. And soon it will be found that a special membrane has been formed around the cell contents. Upon germination slit-like openings are formed in the old spore membrane, and the new inner membrane, and the contents escape, surrounded by an exceedingly delicate covering. The contents are now not a single oval body, but composed of four greenish oval masses, each surrounded by a hyaline membrane. Now and then, by abortion, there are only two or three oval masses, but the normal number is four. After the four cells have remained some time enclosed in the hyaline covering, this becomes

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subsequently reabsorbed, and the four cells lie still and motionless. After a short time they break at one end by a circular slit, and the apex separating becomes elevated like a lid. Through this opening the contents emerge in the form of an oval zoospore, paler at the foremost end, which is furnished with movable cilia. Thus four active zoospores are normally the produce of one oospore, and these are in all respects similar in size, form, and movement to those we have seen originating male organs, or produced, asexually, from the cells of the filament. From this point, the same process is repeated. The zoospores move about freely for a time in the water, they then gradually become more sluggish, finally they become still, the pale end is directed downwards, the cilia are absorbed, an expansion like a radicle is formed, and by this it is fixed. Then the upper portion elongates, the apex becomes a growing point, a septum cuts off the first new cell, and a young plant has fairly started on its career, to produce in its turn its own oospores, androspores, and asexual zoospores, even as its parent had done.

We have now traced the life history of *Œdogonium crassiusculum*, and, as far as we can judge, the cycle seems to be tolerably complete. We have had to guess at nothing and to assume nothing; the continuity is unbroken, and, strange as some of the phenomena may be, there is no offence against our judgment or our experience, and no reasonable foundation for doubt.

To such a story it is unnecessary for me to append a moral at the end, such as we find in all goody-goody books for goody-goody boys and girls. Yet, I cannot help asking you, as naturalists, whether organisms about which such a history can be written do not deserve a more widely extended study than they as yet receive. Any of you may take a phial in your pocket and trudge to Sutton Park. If you have none other, utilise that which held your last "black draught." If that fails, be content with a pill box, or even a square of brown paper. There are certainly some half a dozen species to be found there. By perseverance and experience you may find them all, and trace out their history. You require no elaborate apparatus, only three things, all of which are essential:—(1) A microscope; (2) ability to use it; and (3) a good resolution. With these no one needs to fail.

This may be a humble organism that I have brought to your notice, it may be a low form of vegetable life, one of the lower Cryptogamia—facts which I am not prepared to dispute. They live, vegetate, thrive; some in rather dirty places, collecting their own food, supporting themselves by the exercise

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of their own powers, pass through childhood, youth, manhood, and age; enjoy the pleasures and sorrows of conjugal life, but with only one object, as far as we can see, although in æsthetic eyes they may have a higher—to live and reproduce their species, to increase and multiply, and replenish the waters. Of how many higher organisms could we say—nothing more.

THE LIAS MARLSTONE OF LEICESTERSHIRE AS A SOURCE OF IRON.

BY E. WILSON, F.G.S., CURATOR OF BRISTOL MUSEUM.

(*Continued from page 66.*)

North of Tilton Station, at Halstead, there is an extensive working of the West Yorkshire Iron Company in the upper beds of the weathered Marlstone at its outcrop on the hillside. The Marlstone Rock and underlying shales are also well shown in the railway cuttings immediately north of Tilton Station. In the neighbourhood of Billesdon there are several interesting exposures of the Rock-bed, which, in that neighbourhood, attains a thickness of over twenty feet. Billesdon Coplow, a hill famous in hunting annals itself, bears a small capping of this stone. Going south from Tilton the Marlstone Rock can be traced as a terrace on the hill sides by Lodington and East Norton to Allexton and Stockerston and thence by Hallaton to Slawston and Medbourn. In this direction a great change takes place, the Rock-bed thinning away very rapidly. At Billesdon and Tilton the Marlstone Rock is from eighteen to twenty feet in thickness, but at Allexton it is only two feet, and between Keythorpe and Hallaton not more than one foot in thickness. In the neighbourhood of Cranhoe, Hallaton, and Blaston the Rock-bed is so thin as to be scarcely traceable; it has, however, been observed in the outliers of Slawston Hill, Staunton Hill, and Great Bowden. South of the Welland the Marlstone reappears in a modified and attenuated form at Ashley Sutton Basset and Market Harborough, and three or four miles west of this latter place it forms an outlier between Gumley and Laughton.

To the north of Melton Mowbray the Marlstone constitutes a considerable outlier at Holwell. It is extensively quarried in the vicinity of that village by the Holwell Iron Company and the Stanton Coal and Iron Company. The ordinary ferruginous stone alternates with brashy shell beds or jacks,

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and a few local blue-hearted encrinital bands. The ironstone is here well jointed, a feature which facilitates its extraction. The lower arenaceous and unproductive beds appear in a railway cutting in one of the quarries, faulted against the ferruginous beds.

From Holwell the Marlstone extends westwards by Wartnaby to Green Hill, near Old Dalby. At Wartnaby it is worked close to the edge of the escarpment by the Stanton Iron Company. The stone is friable, and contains very few fossils; this, however, is no disadvantage from an ironmaster's point of view. The ore is taken away by a short mineral line to a tip on the Nottingham and Melton (Midland) line at Old Dalby.

From Green Hill the Marlstone extends eastwards in a fine line of escarpment to the railway tunnel at Long Clawson. At this point the Rock-bed and underlying Lias shales have been broken through and their place occupied by boulder clay to a depth of nearly one hundred feet. From Long Clawson the Marlstone Rock bends round to the north-east along the well-wooded heights of the Belvoir Hills to Belvoir Castle, that noble edifice itself crowning a diminutive outlier of this rock. On the way we pass the extensive workings of the Eastwell Iron Company, situate at the edge of the escarpment, about two miles south of Stathern Station. The ironstone here is porous and highly absorbent, containing as much as 25 per cent. of moisture, and is but slightly fossiliferous. It is quarried along two working faces nearly half-a-mile in length. At the crest of the hill the cutting for the tram incline, by which the ironstone is taken on to the Great Northern Railway below, shows the Marlstone Rock, of which twenty-five feet are exposed, resting on Middle Lias shales.

At the time of writing ferruginous marlstone is also exposed in the cuttings of the Eastwell branch of the Great Northern Railway, and also of their Eaton branch, north of its junction with the Eastwell branch. At Black's Barn, a little south of the Eaton viaduct, the Marlstone, twenty-four feet thick, was penetrated in a well beneath thirty feet of boulder clay. The Holwell Iron Company are now working the stone by the side of the new line at Eaton, and the Staveley Company and Messrs. Oakes and Company near Swaine's Lodge, about a mile further north. In the Belvoir district there are numerous exposures of the Marlstone Rock, chiefly in small roadside quarries. Of these we will notice a single one, viz., the Duke's Farm Quarry, near Woolsthorpe Old Church, in order to illustrate the character of the stone in this neighbourhood.

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Section in Marlstone at the Duke's Farm Quarry, near Belvoir.

			Ft.	In.
Soil and rubble			3	0
Ferruginous marlstone, thinly laminated with dark ferruginous streaks			4	9
Fossiliferous bed "jack"			0	9
Ferruginous marlstone			1	0
Second "jack"	0	9	1	2
Ferruginous marlstone, Am. spinatus, Pecten lunularis, P. æquivalvis, Lima pectinoides, Modiola scalprum, Belemnites elongatus, Terebratula punctata, and var., Rhynchonella tetraedra	0	9	1	0
Arenaceous beds (unproductive), massive open jointed, unfossiliferous, blue-centred rock ...			5	4
Rubbly stone			1	0
			18	0

To the south of Belvoir the Marlstone Rock is exposed in the quarries of Woolsthorpe, Knipton, and Branston, and in all of these the junction of the ferruginous and arenaceous beds is very sharply defined. On the high ground opposite Belvoir Castle the Marlstone is worked in a field south of Woolsthorpe Cliff Wood, by the Stanton Coal and Iron Company. Throughout this extensive area, that is to say between Holwell and Scalford on the south, and Woolsthorpe and Denton on the north, or broadly speaking, in the district lying between Melton Mowbray and Grantham, the Marlstone Rock maintains an average thickness of from twenty-five to thirty feet. Over the greater part of this area the upper or iron-bearing beds, generally in a thoroughly weathered or oxidised and friable condition, very favourable for working, are well represented. It is in the above district that the Marlstone is now coming most extensively into the market as an iron-producing rock. Towards this end, very material assistance will be rendered by the new mineral lines of the Great Northern Railway, namely the Eaton and Eastwell branches of the Waltham branch, now rapidly approaching completion, the Woolsthorpe branch of the Nottingham and Grantham line, with its projected extension through Denton to Harston, and by the Midland Railway Company's Holwell Extension branch of their Nottingham and Melton line. At the present time the ironstone is being worked by the Holwell Iron Company, the Eastwell Iron Company, the Stanton Coal and Iron Company, the Staveley Coal and Iron Company,

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and Messrs. Oakes and Company. In the course of time, no doubt, other large North-Midland ironmasters will be induced to make a venture in this very accessible and highly productive ironstone region.

From Woolsthorpe the Marlstone Rock extends by Denton and Harlaxton in Leicestershire to Grantham, and by Barrowby and Great Gonerby to Caythorpe and Welbourn in Lincolnshire. The escarpment due to this rock falls all the way from Woolsthorpe coincidently with the dip of the beds, coupled with a certain amount of attenuation. At Caythorpe the ironstone is being extensively quarried by the West Yorkshire Iron Company and the Stanton Iron Company.

Section in the Marlstone at Caythorpe, near Grantham.

	Ft.	In.
Soil	5	0
Ironstone, thinly laminated, encrinital and shelly beds obliquely laminated	1	0
Ironstone, calcareous rock with ferruginous streaks	0	8
Do. do. with local blue-hearted streaks	2	0
Ironstone, with ferruginous and shelly layers in equal proportions	1	0
Ironstone (good quality)	0	6
Do. shelly	1	2
Fossiliferous bed, "jack," hard blue thinly laminated	0	6
Ferruginous ironstone to base	1	0
	12	10

The ironstone at this place contains an excess of carbonate of lime, analysis showing Calcic carbonate 62·14, and Ferric oxide 25·71. This stone, therefore, is found valuable to mix with ores less rich in lime. The Bestwood Coal and Iron Company use it advantageously in conjunction with the more earthy Eastwell ironstone, and the siliceous Northamptonshire iron ore from Weldon. Beyond Caythorpe the Rock-bed is much reduced in thickness, and its outcrop becomes very narrow. At Leadenham the rock is not more than ten feet thick, though it still forms a feature. In the station yard at this place a few ferruginous flaggy beds are seen resting on compact sandstone. North of Leadenham the Rock-bed rapidly attenuates, and it soon becomes merged in the sloping ground at the foot of the oolitic escarpment. Finally, the Marlstone thins out altogether at Welbourn, and it does not apparently set in again until we reach the village of Burton, near Lincoln, about twelve miles to the north of this place, and then not in a workable form.

(To be continued.)

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THE PHYSIOLOGY OF THE MEDICINAL LEECH.*

BY JOHN B. HAYCRAFT, M.B., B.SC., F.R.S. (EDIN.), PROF. OF PHYSIOLOGY, MASON COLLEGE, BIRMINGHAM.

When blood is withdrawn from the body it coagulates in a few minutes, and forms a solid mass. Not only is this seen in the cup into which the blood may have been shed, but occurs also in the region of the wound, filling this up, and plugging the little vessels which have been cut. But for this coagulation we should bleed to death from the slightest wound. Sometimes the blood loses its power to clot, and very serious consequences ensue. The study of coagulation is, therefore, very important, and physiologists and medical men have paid much attention to its investigation.

While thinking over some obscure questions connected with this matter, in the autumn of 1883, I recalled a fact familiar to every surgeon, viz., that after a leech bite the blood flows from the wound, and is very difficult to staunch; and moreover that the blood which the leech has sucked remains permanently fluid within its stomach. So much was known at that time about the coagulation that I was able to predict an explanation of these curious and hitherto unexplained facts, which my experiments enabled me to confirm. These I will now describe, confining myself to those points which will be of most interest to the general biologist.

A blood-clot consists of a sponge of albumen (fibrin) which encloses the corpuscles in its meshes. When shed from the body the blood contains red and white microscopic particles—corpuscles—floating in a fluid—the liquor sanguinis. Very soon the white corpuscles form small quantities of a very active substance, a kind of ferment, which acts on the liquor sanguinis, and causes the formation in it of this sponge of fibrin. Now this is prevented in some way by the leech.

If you cut out with a pair of sharp-pointed scissors the sucker and gullet of a leech, and after chopping these into very small pieces, place them for an hour or so in very weak salt solution, you will obtain a watery solution, a specimen of which I show you in this bottle. If I add a drop of this to a few drops of blood freshly drawn it will remain quite fluid, while this similar portion will clot in a few minutes.

* Transactions of the Birmingham Natural History and Microscopical Society. Abstract of an Address, read December 9th, 1884.

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We have extracted from the leech then a substance which prevents coagulation. What is it? I am not in a position to answer this question. I have tried to find out, and one of the most distinguished of the German chemists, Professor Schmiedeberg, has tried also, but without success. The smallest quantity only is present, but it has an action on the blood as powerful in its way as the venom of the rattlesnake. A quantity of the substance, obtained as yet in an impure state, less than a grain in weight, will prevent a gallon of blood from clotting.

This substance the leech secretes from its sucker; and if this organ be examined with a microscope, a large number of little glands will be seen opening on its surface. These are single cells and they may be compared with the salivary glands of man, and their secretion—containing the substance —with the saliva.

The saliva of the leech prevents coagulation. How does it operate? It kills the ferment which produces the fibrin from the liquor sanguinis. The experiments conducted in order to prove this point would take long to describe, but I may mention that the saliva although it kills the ferment does not kill the cells which produce it. If a drop of blood be mixed with a drop of this extract of leech saliva and examined with the microscope, carefully warming the preparation with suitable apparatus, the little white corpuscles will be seen moving about as in normal blood.

In this preparation you will see the blood of a crab under the microscope. There are a mass of white corpuscles—no red ones exist—welded together by processes of their protoplasm called pseudopodia. This forms the clot seen in invertebrate blood, which is then due not to the formation of fibrin, but to the fusion of the white corpuscles. We have seen that in human blood the leech saliva does not affect the white corpuscles. These are homologous of those of the crab just alluded to, and we should anticipate then that the saliva will not prevent the clotting of crab's blood. This is the case.

If a small quantity of the extract be injected into the jugular vein of a rabbit or dog the animal will be thrown into a very curious condition, in which it resembles a patient suffering from a disease called hæmophilia. The slightest wound in the skin continues to bleed. In hæmophilia this may lead to fatal consequences, but as the leech saliva is eliminated pretty rapidly from the system, its injection is not so very serious a matter.

Now you will be in a position to see the reason *why* the blood continues to flow for so long a time from the leech-

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bite. In this case there is a local injection of the secretion into the tissues of the wound, and a local effect only is produced. While the leech is sucking, this secretion bathes the wound, and being very diffusible it passes into the tissues around. When the leech drops off at the end of ten or fifteen minutes, the wound is literally soaked with the secretion, and the blood not only flows from the wound, but some of it will probably find its way into the tissues around its edges, so that the skin becomes blue just as if it had been bruised—(this is generally but not always seen). If you wish to stop a leech bite you must wash the wound well with water to wash away the secretion.

To the leech, the possession of this secretion is essential for its existence. It thus obtains sufficient blood for its nourishment. A cut such as the leech can inflict would very soon stop bleeding, and the creature would at most obtain a few drops. But in addition the blood remains fluid within its body cavity. We know—many at least—by our own experience how difficult it is to digest a milk-clot; for the coagulation of the milk within the stomach is perhaps the chief reason that it is to some a forbidden article of food. So with the leech; it can easily assimilate the fluid blood, but its digestive juices would refuse to attack a solid blood-clot.

THE PRE-CARBONIFEROUS FLOOR OF THE MIDLANDS.

BY W. JEROME HARRISON, F.G.S.

(*Continued from page 73.*)

5.—*The Silurians of Walsall.*—Ten miles due west of Dosthill, the intervening space being occupied by the Trias, we find a considerable area of Upper Silurian beds lying around and east of Walsall. The lowest stratum exposed is the *Upper Llandovery or May Hill Sandstone*, which crops out near Hay Head and at Shustoke Lodge, two miles east of Walsall.* It is here very fossiliferous, and has a westerly dip. The rocks which lie below it are not visible, but if the fault which has brought the May Hill Sandstone to the surface had had but a little greater throw, we should, doubtless, have found Cambrian or Pre-Cambrian rocks at the surface, for the entire thickness of the Lower Silurian strata is wanting in this part of South Staffordshire.

* Jukes' South Staffordshire Coalfield; Suney Memoir; p. 109.

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The overlying beds include the Barr or Hay Head (Woolhope) limestone; then 800ft. of Wenlock shales (well shown in the railway cuttings); and lastly, at Dun End and Walsall Town, the two bands of the Dudley (=Wenlock) limestone; these being immediately overlaid by coal-measures, the whole series of rocks dipping westerly.

6.—*The Silurians of Dudley and Sedgley.*—Crossing now to the western boundary of the South Staffordshire Coalfield, we find that also formed by a fault, which has again brought Silurian rocks to the surface. But as the throw of this fault is somewhat less than that of the eastern boundary, we here, at Sedgley, find the lowest rock exposed to be the *Wenlock Shales*. Above these come the two bands of Dudley (=Wenlock) limestone, then a great thickness, perhaps 1,000 feet, of *Ludlow Shales*, near the top of which we find the Sedgley (=Aymestry) limestone. Although the beds undulate, their *general* dip is to the east.

A little south of the Sedgley area the Silurian rocks again rise to the surface in the two dome-like masses of the Wren's Nest and Dudley Castle; here we get the Wenlock shales and limestone only. A little farther south there is a small exposure of the same beds at the Lye. Thus far we are able to see a strong resemblance between the structure of the South Staffordshire and the Warwickshire Coalfields. Each is bounded on the east and on the west by faults which run north and south, and by which the rocks lying beneath the coal measures are brought to the surface. The differences, however, are considerable. In Warwickshire the boundary line is a double fault, and the rocks brought up are Cambrians, while in Staffordshire they are Silurians. The coal-seams of Warwickshire, moreover, increase in depth from the surface, and pass beneath newer rocks as we follow them southward, and the southern boundary of that coalfield is unknown. But in Staffordshire just the opposite happens; we know that the coals there terminate in a southerly direction against a buried ridge of Silurian rocks, the actual outcrop of the seams being hidden by the upper coal measures which overlap. But a little further south these old Silurian rocks, and others of still greater antiquity, are brought to the surface in a manner which strongly reminds us of the Hartshill region.

7.—*The Lower Lickey Hills.*—The Lower Lickey Hills form part of the southern boundary of the South Staffordshire Coalfield. They consist of a low camel-backed ridge, some 500 feet in height, running from north-west to south-east for between two and three miles. Access is easy from the Barnt Green Station (at the southern end of the ridge), on the

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Birmingham and Worcester line; while a new railway has lately been opened from Rubery (at the north end) to Halesowen.

The basement rock of the Lickey is best seen along a stream-course at the southern end of the hills. It is a greyish blotchy rock—probably an altered volcanic ash—which has harder (quartzose) bands in its upper part; only a small area is exposed, and there is no good section. This rock is probably of Pre-Cambrian age.

Next in order we get the hard, much-jointed, greyish-white to red quartzite, of which the main ridge is composed. It is well exposed in numerous sections—that at Rubery Station being especially fine—where it is worked for road-metal. The thickness of the quartzite is about 350 feet, and its prevailing dip is to the north-east, at angles of from twenty to thirty degrees. But at the Rubery end of the hills—where the section is most complete—the quartzite rolls over, and dips westward, thus forming a true anticlinal. No fossils occur in the quartz-rock, but whitish specks of decomposed felspar are common in it. At the southern end of the ridge the rock is much contorted. The geological age of the quartzite is again a matter of difficulty. Lithologically it is identical with the Hartshill quartzite, and rests, like it, upon Archæan strata. The Cambrian shales—which probably come above the quartzite—are here hidden by the overlap of the Silurian strata. The quartzite is, without doubt, either Cambrian or Pre-Cambrian, but, in the absence of fossils and of sections showing its relations to the rocks above and below it, it is hardly possible to refer it with certainty to its precise geological horizon.

Above the quartzite we find representatives of several Silurian rocks. First we get the May Hill Sandstone—a coarse, friable rock full of characteristic fossils, *Stricklandinia lirata* being especially numerous—which is well seen in the road-cutting at Snead's Heath, just opposite the wall of the Lunatic Asylum. Here the newer sandstone rests upon an eroded surface of the metamorphosed rock, filling up its hollows, and containing rounded pebbles of the quartzite. There are hard quartzose bands in the May Hill Sandstone, and these probably led to the erroneous idea—promulgated by Murchison and endorsed by the Geological Survey—that the Cambrian quartzite of the Lickey was simply a metamorphic form of the May Hill rock which reposed upon its flanks. The true facts of the case were observed by Professor Lapworth and Mr. Houghton early in 1882; the underlying Pre-Cambrian strata were discovered by the former geologist a little later, the clue to them being afforded by the rocks of like age which underlie the quartzite of Hartshill.

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Above the May Hill Sandstone of the Lickey are Silurian shales with irregular bands of limestone representing the *Woolhope Limestone*, while at the southern end of the ridge, near Barnt Green, an old quarry in a wood reveals the *Wenlock Limestone*. At the northern end, where the anticlinal is complete, Silurian rocks occur on the east and on the west sides of Rubery Hill, and these are overlaid in turn by coal-measures. Above these come Permian and Triassic strata, which abound in fragments of the older rocks.

8.—*The Wrekin and Church Stretton District.*—The Pre-Carboniferous rocks of Shropshire have been so ably described by Dr. Callaway that it will be only necessary to briefly recapitulate his conclusions.

About twenty miles north-west of Dudley—at Lilleshall, in Shropshire—we reach the termination of an axis which extends from this point to the south-west for thirty or forty miles, and along which Cambrian and Pre-Cambrian rocks have been brought up on the east side of a line of fault. The Pre-Cambrian rocks were mapped by the Survey as intrusive greenstones, while the Cambrians were regarded as Silurian strata altered by the heat, &c., proceeding from the said greenstones at the time of the intrusion! Mr. S. Allport was the first to prove that the so-called greenstones were really bedded volcanic rocks.* They occur as isolated bosses at Lilleshall, the Wrekin Range, Wrockwardine, and Charlton Hill. Then there is an interval of six miles (occupied by Cambrian and Silurian strata) when the Pre-Cambrians again form the rounded hills north and east of Church Stretton, known as the Lawley, Caer Caradoc, Cardington Range, &c. The beds of altered volcanic ash, lava, &c., have a general strike from east to west, or *across* the direction of the ridges which they form.

Resting unconformably upon these volcanic rocks we find a quartzite, about 200 feet thick, identical in appearance with that of the Lickey and Hartshill.

Above the quartzite—where the section is most complete, as on the east side of the Wrekin—is the Hollybush Sandstone, greenish or brown in colour, and about 300 feet thick. Its fossils prove it to belong to the *Upper Lingula Flags*, so that it is of Upper Cambrian age. Above this sandstone, which is little altered, are the Shineton shales—bluish shale, 1,500 feet thick—containing many new species of fossils, which Dr. Callaway places on the horizon of the Lower Tremadoc Beds, and which must be of pretty nearly the same age as the Stockingford Shales of Warwickshire.

* Quarterly Journal Geological Society, Vol. XXXIII., p. 449.

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Next come the Silurian strata, and we now meet, for the first time, with representatives of the Lower Silurian formation, in the shape of Caradoc sandstones and shales; but even these are not found north of the Severn, while the Arenig Beds and the Llandeilo Flags are still wanting. Neither is there any trace of the Lower Llandovery Beds, but the Upper Llandovery, or May Hill Sandstone, rests unconformably on all the rocks below it, while above it come all the Upper Silurians in due order—this is, indeed, their typical district—the Woolhope, Wenlock, and Aymestry Limestones forming long ridges, running from north-east to south-west (of which Wenlock Edge is the most prominent), while the softer shales form the valleys between. Then, west of Bridgnorth, and south of Broseley, we find the Old Red Sandstone here terminating its north-easterly extension. Of the Lower Carboniferous strata the Mountain Limestone and Millstone Grit are but feebly developed at Lilleshall and south-east of Wellington; while fifteen miles further south, in the Brown Clee Hills, the Coal-Measures repose upon the Old Red Sandstone.

(To be continued.)

THE PRINCIPLES OF BIOLOGY.

BY HERBERT SPENCER.

BY LEWIS J. MAJOR.

ABSTRACT OF CHAPTERS VIII. AND IX., VOL. I.

HEREDITY.

The universal law of Heredity is that each plant or animal produces plants or animals of the same general structure with itself, and though the various instances of heterogenesis, as given in the preceding chapter, are at first sight at variance with this law, they are not really so, the recurrence of forms being cyclical instead of direct. But the law of Heredity applies not only to main characters of structure but also to the smaller details, and though the tendency to repetition is qualified somewhat by the tendency to variation, the law may be considered as unlimited. Thus the members of any one sub-species habitually transmit their distinctive peculiarities to their descendants. We have, for example, several varieties of wheat, many varieties of potatoes and peas and of numerous other vegetables, not to speak of flowers.

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Such variations from the original type would be impossible were it not that distinctive peculiarities, encouraged by a natural or artificial selection, have been and are habitually transmitted in an equal, in a greater, or in a less degree. In the absence of other evidence that which ethnology alone furnishes would suffice.

The illustrations of Heredity are then divided into two classes—(1) cases where congenital peculiarities, not traceable to any obvious causes, are bequeathed to descendants; (2) cases where peculiarities, not congenital, but resulting from changes in function during the lives of the individuals bequeathing them, are inherited. The necessity of this distinction is not very evident, and seems only to confuse, as there are many instances of Heredity which it would be difficult to place under one class more than the other. There are numerous instances of the inheritance of forms modified by natural and artificial selection, of the transmission of special deformities, of the inheritance of diseases, of peculiarities of skin and of teeth, &c., whilst the direct inheritance of an acquired peculiarity is sometimes observable. Mr. Lewes gives a case of a puppy that took to begging spontaneously (an accomplishment of his mother), and young pointers have been noticed to stand and point when first taken into the field.

[The inheritance of an acquired peculiarity can be by no means uncommon. Most people can recall instances of an inherited twitching of the mouth or eyes, of a peculiar way of shaking hands or even of holding a teacup, and of numerous other cases of the inheritance of the minutest details of habit. Darwin, in the expression of the emotions, gives a very singular instance— where a trick of lifting the arm and dropping it again with a jerk on to the nose, during sleep, was observed to be inherited.]

As an instance of functional Heredity, Spencer particularly cites the musical faculty, the growth of which he explains in a remarkably clear and powerful manner. There are two modifications of Heredity given on p. 252; atavism, and the limitation of Heredity by sex, to which we may add what Darwin styles a much more important rule than either of these, viz., that at whatever age a change appears in the parent, it appears in the offspring, *e.g.*, horns in cattle.

[Even peculiarities of structure will appear at the same age in the offspring as in the parents. In a family known to a friend of mine, with several members of two generations, one of the eye-teeth has failed to appear till they have reached twenty-two or twenty-three years of age.]

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Variation.

No organism is exactly like its parent. Variation is co-extensive with Heredity, and the evidence which proves Heredity in its smaller manifestations is the evidence which proves variation, for it is only when there occur variations that anything beyond the transmission of structural peculiarities can be proved.

The transmission of variations is itself variable. An individual trait in one parent may be counteracted in the offspring, or may appear in an equal, or in a less, or in a higher degree. An instance of this is cited from Dr. Struthers of a family in which the transmission of digital increase was traced through four generations varying in position and degree.

Though unlikeness among progenitors is one antecedent of variation, it is by no means the only one, for successive offspring of the same parent are never exactly alike. This is accounted for by the functional variation of the parents, and is shown by the fact that twins are more nearly alike than children born in succession. But why are not seeds out of one pod and animals born at one birth exactly alike? There is another cause for variation yet to seek. In any series of dependent changes a small initial difference often works a marked difference in the result—instance the great likeness that exists between all babies a few weeks old. And again, no two parts of any aggregate can be similarly conditioned with respect to incident forces. Hence, no two ova, no two ovules, no two spermatozoa, no two pollen-cells can be identical, and the reproductive centres must begin to differentiate from the very outset.

The inferences from the power that organisms display of reproducing lost parts is, that the units of which an organism is built have an innate tendency to arrange themselves into the organism, but as reasons have been given for believing that the reproductive cells are not highly specialized, and it was actually seen in one of the organisms that the units of each undifferentiated cell were capable of arranging themselves into the form of species, we are driven to the assumption, as Spencer says:—

(1.) That sperm cells and germ cells are essentially nothing more than vehicles in which are contained small groups of the physiological units in a fit state for obeying their proclivity towards the structural arrangement of the species they belong to.

(2.) That the likeness of any organism to either parent is conveyed by the special tendencies of the units derived from the parents.

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(3.) That in the progress of evolution of the fertilised germ, the two kinds of units are working in unison to produce an organism of the species from which they were derived, but in antagonism to produce copies of the respective parent organisms.

NOTES ON THE NATURAL HISTORY OF SUTTON PARK

(SITUATED IN THE NORTH-WEST EXTREMITY OF THE COUNTY OF WARWICK).

BY W. HARCOURT BATH.

The Bittern.—Although a rare occasional visitor, I believe the bittern had never been known to breed in these parts until last year, when I had the fortune to discover its nest. The haunt of this bird was in a thick wooded morass at the head of one of our largest pools, which it is almost impossible for anyone to penetrate except after an absence of rain for several weeks. During some fine weather in June last year I was engaged in exploring this bog in quest of information. I entered from the land side, and after some time and care spent in springing from one clump of reeds to another in order to evade the water, in doing which I was obliged to guide myself with the branches of the trees, I managed to arrive close to the water's edge.

The nest was about a yard from the pool, and was difficult to discern at first sight, as it was almost entirely obscured from view by the quantity of vegetation growing around it.

It was built very high up out of the water on a mass of reeds, in order to protect it, I presume, from a sudden rising of the water to which these bogs are very liable. It was composed exclusively of sticks and reeds, the inside being lined with the latter. In size it was somewhat similar to that of a coot's nest.

The eggs were partially hidden from view by a thin layer of reeds, which had the appearance of having been hurriedly put on in order to prevent their detection.

On removing this I found the eggs five in number and all quite warm, which proves that the parent bird must have left them only at the last minute.

The colour of the eggs is pale ochreous-brown, and their shape is similar at each end. They may be readily distinguished from the egg of any other bird on account of their soft velvety touch and beautiful glossy appearance.

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The Black Tern.—A pair of these birds has the last two years been known to breed in one of the marshes, but at present I have been unable to discover the whereabouts of their nest.

They arrive here about the end of April or beginning of May. A single specimen was shot on one of the pools in the summer of 1882.

Long-Eared Owl.—Each year since my residence at Sutton I have been accustomed to find the nest of this bird.

Its situation is usually selected about the end of February or beginning of March, and about a week later the eggs, from four to six in number, are laid, and ten or twelve days afterwards the birds commence sitting. This bird never builds a nest of its own, but appropriates some disused nest of a crow, sparrow hawk, or magpie, entwining among the sticks a little dried grass, and on this placing a mass of feathers which the old bird plucks from its own breast.

The young are full fledged towards the end of April, and in May and June may be seen on moonlight nights in company with their parents scouring the woods in search of prey. They very seldom show themselves in the open, though I have seen them on several occasions. Their food consists principally of small birds, mice, and shrews, judging from the quantity of pellets found in their haunts.

During the day, the long-eared owl is very sluggish, and may be approached within a very short distance, but it is seldom seen in the day time, except on rare occasions, as it effectually hides itself in the thickest parts of the woods, and bears such a close resemblance to the trunks of trees in colour.

When disturbed off its nest, it almost invariably drops down immediately into the bushes, and very seldom flies far away, except on an exceptionally dull day.

I have never heard this species of owl utter a call.

The Kestrel.—It is rather singular that this bird in North Warwickshire, and especially in the neighbourhood of Sutton, should be of less frequent occurrence than the *Sparrow Hawk*, which is usually the opposite in other parts of the country. Where twenty of the latter are seen, there is not one of the former. Can any of your readers explain this?

The Stone-chat I believe is only a summer visitor to these parts, arriving about the 1st March, and departing again in November. It would be interesting to know in what localities it stays throughout the winter. Probably some of your correspondents on the South Coast will kindly inform us.

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The Adder is by no means extinct here. I am frequently informed of single specimens having been seen. A large retriever dog belonging to a friend of mine died last year from the effects of a bite of one of them.

I captured a specimen last spring, in the bogs near Bracebridge Pool; it measured twenty-three inches in length. Old residents inform me that the viper used to literally swarm on the Coldfield about twenty years back.

The Ringed Snake is less frequently seen, though a few occur near Walmley (about three miles from here) in damp situations.

Pine Marten.—A single specimen of this now somewhat rare animal was seen by myself in Upper Nut Hurst last summer. I was only about four feet off when I first saw it asleep in the sunshine on the low branch of an oak. When awakened it darted immediately up the tree and hid itself from view, and although I waited about half-an-hour afterwards, and continued to throw up stones with the hope of seeing it again, I had to turn away disappointed.

The Squirrel is still not uncommon in the less-frequented woods, and any early morning's walk will reveal it to the enquirer. Their nests may be seen any time; the usual situations being in the forket of an oak tree, or at the top of some thick pine or holly. They usually breed in May, and have from three to five young ones at a birth. A nest at the top of a thick holly tree that I found last year contained three young ones,—the prettiest little creatures in creation. The nest measured about twenty inches in length, and nine or ten inches thick. The outside was composed of the twigs of the pine tree, and the inside lined with the needles of the same; it was oval in shape, and slanting in order to let the rain run off; there were two openings, one at each end, which, however, are always kept closed. When I touched the top the young ones scrambled out and ran down the branches of the tree to the ground, uttering squeaks in doing so. I captured one of them and took it home, and fed it upon bread and milk; it appeared to be very docile, but only survived a few days.

Squirrels seldom become dormant in these parts but remain lively all the winter through. They are amply provided with food, but their numbers seem to be steadily on the decrease.

The Glow-Worm.—Mr. T. B. Grove informs me that he saw one of these insects last summer on a bank in Holly Hurst. I believe this is the first recorded in Sutton Park. Perhaps Mr. Blatch can inform us.

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Anodonta anatina.—I have seen great quantities of this shell at a large pool at Langley (2½ miles from Sutton), belonging to a friend of mine. Some of the specimens are of an unusual size.

Birds that nest earliest in these parts:—

Name.	Date.
Rook	February 19th—March 1st.
Redbreast ...	February 29th—March 14th.
Long-eared Owl ...	End of February and beginning of March.
House Sparrow ...	Beginning of March.
Starling	Ditto.
Carrion Crow ...	March 14th—19th.
Hawfinch ...	Middle of March.
Heron	Ditto.
Common Wren ...	Ditto.
Mistletoe Thrush	End of March.
Song Thrush ...	Ditto.
Blackbird...	Ditto.
Hedge Accentor ...	Ditto.
Wild Duck ...	Ditto.
Teal	Ditto.
Lapwing	Ditto.
Snipe	Ditto.
Ringdove... ...	Ditto.
Green Woodpecker	Ditto,
Lesser spotted ditto	Ditto.
Jackdaw	Ditto.

(To be continued.)

METEOROLOGICAL NOTES.—February, 1885.

Barometric pressure was decidedly unsteady this month, and the changes numerous and rapid. The height of the mercurial column was about 29 inches at the commencement of the month; about 30 inches at its close. The weather was generally unsettled. The mean temperature was about 2 degrees above the average, although a short "spell" of frost occurred about the 21st, when the readings were lower than those in February since 1879. The range of temperature was unusually wide. The highest maxima occurred on the 24th, and were—59·2° at Loughborough, 59·0° at Henley-in-Arden, 57·9° at Hodsock, 57·4° at Strelley, and 57·1° at Coston Rectory. In the rays of the sun, 99·1° was registered at Hodsock on the 28th, 97·1° at Loughborough on the 12th, and 93·0° at Strelley on the 28th. The lowest minima were on the 21st, and were 18·8° at Hodsock, 20·3° at Coston Rectory, 21·0° at Loughborough and Henley-in-Arden, and 22·3° at Strelley; 13·3° was registered on the grass at Strelley and

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Hodsock, and 15·6° at Loughborough, also on the 21st. Rainfall was slightly above the average, the total values for the month being 3·50 inches at Henley-in-Arden, 2·56 inches at Loughborough, 2·38 inches at Strelley, 2·35 inches at Coston Rectory, and 2·19 inches at Hodsock. The greatest fall occurred on the 16th, and varied from 0·64 to 0·52 of an inch. A little snow fell on two or three days. The prevailing winds were southerly, and occasionally strong in force. Sunshine was again deficient. A lunar halo was observed at Loughborough on the evening of the 27th.

WM. BERRIDGE, F. R. Met. Soc.
12, Victoria Street, Loughborough.

Natural History Notes.

THE MIDLAND UNION.—The Birmingham Societies are making vigorous preparations for the Annual Meeting of the Union, which is to be held in Birmingham in the middle of June. We trust that all the Societies in the Union will arrange their Meetings so as to leave the days selected (June 16th and 17th) free, and that a large number of their members will take part in the General Meeting, and attend the Soirée and Excursions.

THE AQUARIUM DEPARTMENT will form an attractive feature of the forthcoming Inventions Exhibition. Lord Onslow has lately presented 1,500 exceedingly fine carp; and a large number of fish indigenous to the Canadian Lakes have also been received for exhibition.

THE FAUNA OF WARWICKSHIRE, WORCESTERSHIRE, AND STAFFORDSHIRE.—As I am compiling for publication lists of the Fauna of the above-named three counties, I shall be very much obliged for any assistance that the readers of the "Midland Naturalist" can give me. I am particularly in want of lists of Insecta occurring in the three counties, with their localities and notes on abundance or scarcity, &c. Specialists wishing to contribute will kindly correspond with W. HARCOURT BATH, Sutton Park, near Birmingham.

PROFESSOR HILLHOUSE, it is announced, will shortly publish, through Messrs. Sonnenschein and Co., an English version of Professor Strasburger's "Das Kleine Botanische Practicum," itself an abridgment of a much larger work published in the spring of last year. The book is intended primarily for students and practical workers, and, commencing with the most elementary researches, with the aid of the simplest apparatus only, it is carried up to embryological and other complex work. The volume will be fully illustrated by woodcuts drawn by the author, who is adding fresh notes of most recent information.

A NEW PROTOZOON.—The new chlorophyllogenous protozoon, discovered by Mr. Thomas Bolton, has recently been described by Professor Ray Lankester. He has named it after its discoverer, and after Mr. William Archer, of Dublin (the discoverer of so many Heliozoa), *Archerina Boltoni*. It is simply a sphere of dense protoplasm, with radiating pseudopodia, one or more vacuoles (but none contractile), and a single or bifid chlorophyll corpuscle. It passes through actinophryd, encysted, and vegetative stages. Some may regard it as a case of symbiosis between a moner-like protozoon and a unicellular alga, but Professor Lankester thinks there is no ground for such a supposition.

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ORIGIN OF THE VERTEBRATA.—The question whether the Vertebrata are derived from a worm-like ancestor or from a nemertine-like form, which gave rise to the Vertebrata on the one hand and the Annelids on the other, has long been of deepest interest to morphologists. Mr. J. T. Cunningham, Director of the Scottish Marine Survey, discusses the subject in the recent issue of the "Quarterly Journal of Microscopical Science," and strongly advocates the theory which regards the Vertebrate as a worm turned on its back. Since in the Worm the œsophagus is embraced by two nerve-cords connecting the brain and ventral nerve-cord, but in the Vertebrate no such arrangement exists, the brain and spinal cord being entirely dorsal to the alimentary canal, the theory requires that a remnant of the original annelid mouth and œsophagus should be found in the vertebrate brain. This remnant Mr. Cunningham finds in the Infundibulum of the brain, which is a deep conical depression on the ventral surface in connection with the Pituitary body, the latter being regarded by Dr. Dohrn as the rudiment of a gill. Mr. Cunningham also regards the notochord as of mesoblastic, and not of hypoblastic origin, as hitherto supposed, and homologous with the three giant fibres beneath the nerve-cord in the earth-worm.

BOTANICAL RESEARCH.—A writer in "Nature" (March 19th) gives a few very interesting particulars of the much-increased facilities which are now offered to a student who, having completed his botanical course at our Universities, desires to plunge at once into some original research. Instead of the customary method of visiting Germany, and there sitting at the feet of one of the giants of botanical science whose names have been so familiar to him throughout his University course, he can now avail himself of the opportunity offered at the Botanical Garden at Buitenzorg, in Java, where, in a not unhealthy locality, he would have all the rich materials of a tropical flora at his command. Dr. Treub, the Director of the Garden, who speaks English, has accommodation in his laboratory for four investigators simultaneously, and the offer is made freely to those of any nation. But even in Europe we have now, besides the well-known station at Naples, a second marine station at Antibes, in the south of France, where, on suitable application, foreigners can obtain admission to the laboratories of the Villa Thuret, and prosecute their researches under the directorship of M. Naudin. The writer also refers to the Jodrell laboratory at Kew, and laments that so little is done by us to utilise in our gardens at Calcutta and Peradeniya opportunities as great as those which the Dutch have at Buitenzorg. There is hope, however, that as regards Britain, the Marine Biological Associations will remove the reproach under which we now labour that there is no station at which an earnest student could prosecute his studies in marine botany, without accepting the help of a foreign Government.

ENCOURAGEMENT OF SCIENTIFIC RESEARCH.—The Royal Society of New South Wales offers its medal and a money prize for the best communication (provided it be of sufficient merit) on each of eight subjects of scientific interest. Among these are:—Anatomy and Life-history of the Echidna and Platypus; Anatomy and Life-history of Mollusca peculiar to Australia; Tin Deposits of New South Wales; Iron-ore Deposits of New South Wales; List of Marine Fauna of Port Jackson, with descriptive notes, &c., as to habits, distribution, &c.; Infusoria peculiar to Australia. The competition is open to all the world, without any restriction, excepting that the competition must be either wholly or in part original—mere compilation will not be sufficient.

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THE GEOLOGICAL SURVEY.—The year 1883 witnessed the completion of the one inch to a mile geologically-coloured map of England and Wales. Commenced by De La Beche in 1835, the work was continued by Murchison and Ramsay, and has been completed under Geikie. But although the map is nominally completed, much remains to be done. Some of the staff have been transferred to Scotland, but Mr. H. B. Woodward is engaged in Dorsetshire—preparing an important memoir on the Oolite—and others are revising, correcting, or adding to the work previously done in other districts. The fact is, we want (1) a re-survey of the country on the six-inch scale; for we have learnt much since the West of England and Wales was mapped—thirty to fifty years ago—and the old maps are partly obsolete: (2) the preparation of an independent set of drift maps, showing the surface deposits so important to the agriculturist; and (3) the issue of descriptive memoirs which shall treat fully of the nature and contents of the rocks.

THE ORDNANCE SURVEY.—Having completed the map of Scotland, on the scale of six inches to a mile, the officers and sappers of the Royal Engineers have for the last year or two been very busy in the Midland Counties of England. Their poles and marks are conspicuous objects on every hill-top, and already numerous maps of various parts of the district have been issued by the agents—Longmans, Stanford, &c.—for the sale of Government publications. Maps of the whole country on the scale of six inches to a mile, and of towns on the scale of twenty-five inches to a mile, are being executed. The immense value of the six-inch maps to all engaged in scientific pursuits need not be indicated. The detail of these maps is such that they show the outline of every field and the position of every tree. The geologist will, for the first time, be able to lay down accurately on a large scale map the results of his observations, and the archæologist and the botanist will derive equal benefit. It is hoped that the entire Survey will be completed by 1890.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—GENERAL MEETING, February 17th. Mr. Wm. Pumphrey, of Bath, displayed a series of photo-micrographs, and read a paper in which he gave a description of the apparatus, and method by which they were produced. He called attention to the great advantage obtained by the use of parallel rays—such parallelism being obtained by causing the light (in this case the light from a powerful paraffin lamp) to traverse two apertures, placed 1½ inches from each other, interposed between the lamp and the object. By this means the intervention of a condensing lens is dispensed with, and a much finer definition attained. Mr. Pumphrey concluded by a display on the screen of a great variety of objects. The selection embraced portions of insects, such as the head appendages of gnats, flies, bees, crickets, &c.; sections of wood, bone, and shell; perfect insects, as *Trombidium*, *Pulex*, *Pediculus*, &c. In order to illustrate the subject more fully, the objects were shown on the screen, in both the positive and negative condition, by which the company were enabled more fully to appreciate the details of the process and the results. It was explained that the lens used was one of Swift's new 40° 1in. objectives, and that the plates were the extra sensitive (XXXXX) of the Paget Plate Company. The reproduction of those parts of the objects in which the natural colour is inactive excited great attention. At the conclusion a lively conversation ensued, in which many of the members present took part.—

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GEOLOGICAL SECTION. February 24th. Mr. T. H. Waller elected Chairman; Mr. John Udall Secretary. Exhibits by Mr. Waller:—1, A case for microscopic slides, by Russell, of Newgate Street, London; 2, a section of one of the old lavas of Ischia. The special point of interest is the disposition of the glass inclusions in one of the sections of leucite. This is radial instead of parallel to the sides of the section. The event of the evening was a paper, by Mr. Marshall, on "Niagara and its Physical and Geological Conditions." The paper was admirably illustrated with maps and diagrams, and brought together a large and appreciative audience.—GENERAL MEETING. March 3rd. Mr. R. W. Chase in the chair. Mr. Lawson Tait presented a number of photographs of diatoms, &c., which he had received from the Government Museum at Washington. The best thanks of the meeting were given to Mr. Tait for the present. Mr. Chase gave some very interesting notes on the esculent swallow (*Collocallia esculenta*). Mr. J. T. Blakemore exhibited the dead bodies of a spider and a beetle which had been in water for some time and had become covered with fungi, supposed to belong to the genus Saprolegnia. Mr. T. Bolton, *Cercariæ*, or tailed larvæ of the fluke, which had escaped from their intermediate hosts the *Limnæa* (water snail). They were seen under the microscope swimming by the vigorous lashing of the tail, and at other times crawling like a leech by the alternate attachment of the suckers, one surrounding the mouth and the other about the centre of the ventral surface. Prof. Hillhouse, a plant of the Hyacinth that had been grown without light; the leaves were white, but the flowers retained their natural colour and odour. He also exhibited a brass rack for holding a number of microscopic slides while they dry. Mr. W. P. Marshall, a singular abnormal growth of a hen's egg containing a second egg. Mr. J. Morley, the horned ichneumon fly (*Eulophus Nemati*), mounted without pressure by Mr. F. Enock.—BIOLOGICAL SECTION. March 10th. Mr. W. P. Marshall in the chair. Mr. Marshall read some interesting notes on the Roraima Mountain in British Guiana, which Mr. Im Thurm ascended in December last, this being the first ascent that has been made. This mountain is 6,000ft. above the sea level and the summit is twelve miles long by four miles wide, and it may be truly described as the garden of orchids. Beside these plants there are also found interesting species belonging to the *Sarraceniaceæ*, or water pitchers, and the *Utricularieaceæ*, or bladder worts. Prof. Hillhouse illustrated these notes with some excellent models of both these orders, together with the *Nepenthes*, or pitcher plants, and also made some very interesting remarks on the various orders, pointing out their differences and peculiarities. A discussion followed, in which the Chairman, Prof. Hillhouse, and Messrs. France, R. W. Chase, W. H. Wilkinson, and J. E. Bagnall took part. Mr. J. E. Bagnall read some short notes on the uses of mosses, illustrating these by the plants mentioned, and exhibited also a number of mosses from the Nuneaton district; and for Mr. J. B. Stone, *Hypnum cupressiforme*, var. *elatum*, from near Bletchley. Mr. T. Bolton exhibited the larvæ of *Spio seticornis*, with an illustration, and Diatoms with the filaments referred to by Mr. J. Badcock in his paper in the "Journal of the R. M. S.," July, 1884. Mr. R. W. Chase, *Somateria mollissima*, the Eider Duck, showing the various stages from the young to the adult in both male and female; he also gave some extremely interesting notes on the habits and life history of these birds. Mr. W. H. Wilkinson also exhibited a number of lichens from near Crieff, Scotland, calling special attention to the following:—*Parmelia conspersa*, *Physcia speciosa*, *Cladonia squamosa*,

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and *Collema nigrescens*; also *Physcia stellaris*, var. *actinota*, from Blockley.—MICROSCOPICAL SECTION. March 17th. Mr. W. H. Wilkinson exhibited a specimen of the pretty white-flowered Allium from France, sold in shops as the "Star of Bethlehem," in which the central axis was continued upwards through the umbel, then forming a second and smaller umbel of flowers above. He also exhibited an abnormal orange, which Professor Hillhouse explained was a double orange, viz., a second orange, with carpels and rind quite complete, growing inside the other. Mr. C. Pumphrey then exhibited, by the aid of the lime-light lantern, the second series of photographs taken by him during his late visit to America. After showing maps and plans of the district visited, he threw upon the screen a large number of beautiful views, comprising scenes in Quebec, the Falls of Montmorency, Chicago, the steam engines with their peculiar chimneys (spark catchers), the style of carriages used, the railway lines and bridges; also views on the St. Lawrence and Hudson Rivers, showing the tall steamboats used there; views of Lake George, and a very interesting series of pictures of Niagara Falls, showing the grandeur of the falling mass of water from many different points of vantage. The display was much appreciated, and complimentary remarks were made by the chairman, Mr. R. W. Chase, and Mr. W. P. Marshall; and a hearty vote of thanks to Mr. Pumphrey was passed unanimously. —SOCIOLOGICAL SECTION. March 5th. Mr. W. H. France read the second chapter of Mr. Herbert Spencer's "Study of Sociology," and the reading was followed by an interesting discussion.—At a meeting of the Section held on Thursday, March 19th, Chapters 6 and 7 of Part III. of Mr. Spencer's "Principles of Biology" were considered, the discussion being introduced in a paper by Dr. Hiepe.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—February 23rd. Mr. J. W. Neville exhibited twelve botanical sections, double stained, prepared by Mr. G. Wilkes, of Manchester; Mr. Bradbury, a collection of butterflies, from the Malay Archipelago. Under the microscope, Mr. Hawkes showed cirrhi of barnacle (*Balanus balanoides*); also ova of the same and young in the first stage.—March 2nd. Mr. T. H. Waller, B.A., B.Sc., delivered a lecture on "The Microscopic Structure of Rowley Rag," which was largely illustrated by specimens and sections under the microscopes.— March 9th. Mr. Moore exhibited specimens of the slug *Testacella haliotoidea*, from Chiswick; Mr. Tylar, a fossil Echinus, in Lias clay, with spines *in situ*; Mr. Insley, a collection of ferns, grasses, &c., made in Afghanistan and the district. Under the microscope Mr. Tylar showed larva of *Corethra plumicornis*, pierced with threads of hydra; Mr. J. W. Neville, mouth organs of wasp, mounted without pressure, and explained the mode of its preparation.—March 16th. Mr. Wykes showed stems of *Lepidodendron* in true coal. The following objects were exhibited under the microscopes:—Mr. Dunn, pulsations of the heart in *Planorbis vortex*; Mr. Tylar, anchor plates of *Synapta inhærens* and *S. digitata*; Mr. Foster, parasite of Red-throated Diver (*Colymbus septentrionalis*); Mr. Moore, alimentary canal of *Agrion pulchellum*. A paper was then read by Mr. A. Foster on "Some common objects of the microscope," which described the educational advantages to be derived from microscopic observations. The minute structure of entomological, botanical, and anatomical objects was described, and the additions made by the microscope to our knowledge of the structural peculiarities of the objects by which we are surrounded. The paper was largely illustrated by microscopic slides.

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LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY.—Section D.—Zoology and Botany.—Chairman: F. T. Mott, F.R.G.S. Monthly Meeting, March 18th. Exhibits: The Text-book of Zoology, by Claus, translated by Sedgwick; "Notes Algologiques," by Bornet and Thuret; Microscopic slides of *Lyngbya*, *Ulothrix*, *Draparnaldia*, and other algæ, by Mr. F. Bates. A box of marine shells, *Trochi neritæ*, &c., by Miss Adderly. A gathering of mosses from Leicestershire, and another from Hampshire, by Miss Grundy. Four dead freshwater shells taken from the underside of a small piece of *Marchantia polymorpha*, growing on a stone in Bradgate Brook, viz., *Valvata piscinalis*, *Planorbis albus*, *Pisidium pulchellum*, and a very small *Linnæus*, only a quarter of an inch long, probably the young of *Stagnalis*; also a curious small Hepatic, not yet identified, by the Chairman. Specimens of *Erophila vulgaris* (*Draba nerna*) in flower, only three-quarters of an inch high, by Mr. Quilter. Papers (1) "On Heterostylism," by Mr. E. F. Cooper, F.L.S., describing the dimorphic flowers of *Primula vulgaris*, and the trimorphic flowers of *Lythrum salicaria*, and showing how the latter is probably approaching to a dicœcious condition. The paper was illustrated by specimens and drawings. (2) "On a wild bee's nest," by Mr. Thomas Carter, LL.B., describing and exhibiting the clay cells, with cocoons, and pellets of pollen found in the interior of a door lock, which two bees were observed frequently to visit. Also several cells from an inch to an inch-and-a-half long, composed entirely of portions of leaves found in another corner of the same lock. A bee was also exhibited which was believed to be one of those seen visiting the lock, and which appeared to be a species of *Osmia*. (3) "On a possible origin of organic life," by the Chairman, suggesting that as the most fundamental difference between organic and inorganic objects was the greater concentration of energy in the former, the differentiation may have occurred when the concentrating energy which produced this earth from nebulous matter was at its maximum; that as that period is long past, the conditions necessary for such differentiation do not now exist, so that no change from inorganic to organic is now possible, except under the law of biogenesis. It was arranged to take the first field day of the season on April 8th, to Kirby Muxloe Castle.

PETERBOROUGH NATURAL HISTORY, SCIENTIFIC, AND ARCHÆOLOGICAL SOCIETY.—February 19th.—Exhibits:—Mr. A. Gee, various foraminifera and diatoms, including *Isthmia nervosa* in situ; Mr. A. W. Beale, various diatoms, crystals of gold quartz and peacock copper, and the water flea, *Daphnia pulex*; Mr. J. W. Bodger, unripe and ripe capsules of *Tortula muralis*, showing peristome and spores. Miss Perkins exhibited a collection of local mosses, made by the Marchioness Dowager of Huntly, and kindly lent for the occasion. Mr. J. W. Bodger exhibited and presented to the Society, *Balanus tintinnabulum* from the Coromandel coast, *Balanus spinosus* from Ceylon, and *Neritina viridis* from Barbadoes. Dr. W. Easby presented to the Society an apprentice's indenture dated 1714; a Sudbury token, 1793; a Chatteris token, 1813; a March silver token, 1811. Mr. W. Heath presented a cuckoo, *Cuculus canorus*; starling, *Sturnus vulgaris*; skylark, *Alauda arvensis*; chaffinch, *Fringilla cœlebs*; yellow hammer, *Emberiza citrinella*; royston or hooded crow, *Corvus cornix*. Mr. W. Doughty, a barn owl, *Strix flammea*. Mr. G. Thompson, a common gull, *Larus canus*. Mr. W. Heath, jun., a little grebe, *Podiceps minor*. Mr. A. W. Nicholls exhibited *Gnaphalium leontopodium* from the Alps, and *G. uliginosum* from Fletton. Mr. J. Perkins exhibited *Neritina fluviatilis* from River Lane.

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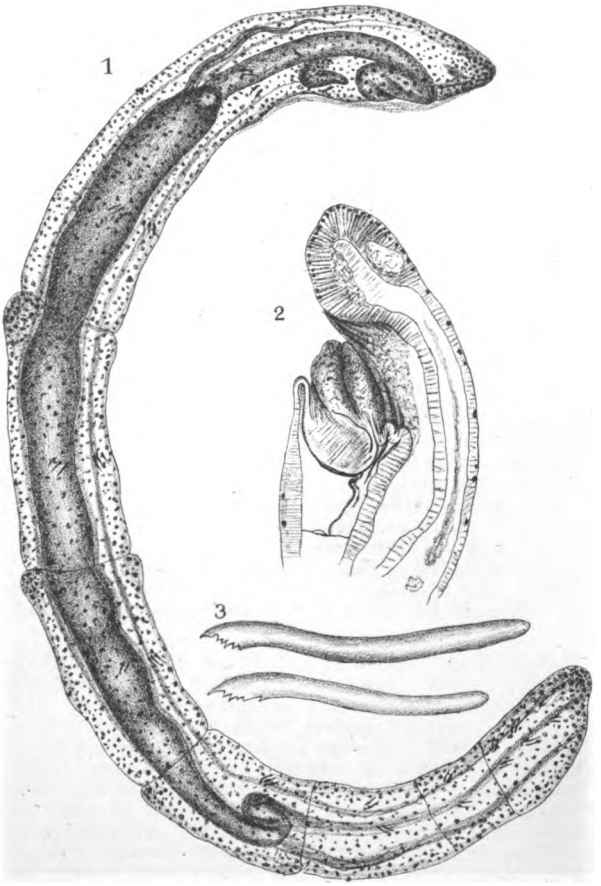
Plate IV



Autor J. Kennel

CTENODRILUS PARDALIS.

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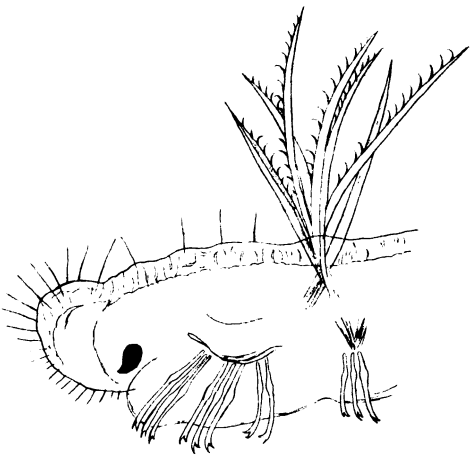
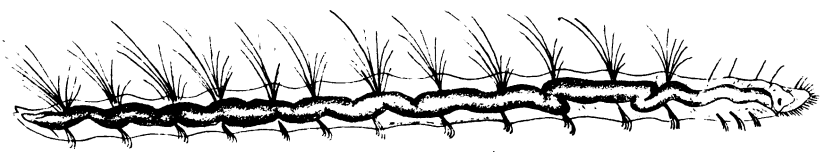
Plate V.





After R. Timm.

NAIS HAMATA

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NOTES ON TWO RARE ANNELIDS.*

BY T. BOLTON, F.R.M.S.

CTENODRILUS PARDALIS.

This interesting little annelid turned up for a short time in abundance in one of the marine aquaria in my studio. It is impossible to say what its source may have been, as I have added organisms to my aquarium from the south-west, and north-east coasts of England, and also from North Wales.

It was described in 1863, by Edward Claparède, from a single immature specimen which he had found two years before near St. Vaast la Hougue, on the coast of Normandy, nearly opposite the Isle of Wight, and was named by him *Ctenodrilus pardalis*, nov. gen. et sp. Professor E. Ray Lankester considers that the same animal was described in 1857 by Oscar Schmidt under the name of *Parthenope serrata*. Dr. J. Kennel gives a long report on this annelid in the Arbeiten Zool. Zoot. Inst. in Wurzburg, 1882, as a contribution to the knowledge of the anatomy and gemmation of annelids. He had the opportunity, in 1879, of examining it very carefully in the Zoological Station of Naples, where it appeared in great abundance in the diatomacean slime on the surface of the tanks in the aquarium.

He gives the following as the characteristics of the genus and species :—

"Fam. *Ctenodrilidæ:* Small marine annelids, consisting of few segments, bundles of bristles on each side bilateral, bristles pectinate at the point, blood-vessel system not closed, dorsal vessel is only in the first body-segments, and opens into the ventral cavity in the first abdominal-segment. A single pair of segmental organs in the head. Continuous multiplication by subdivision in combination with budding-processes. Sexual reproduction unknown.

"*Ctenodrilus:* 12—15 segments, head consisting of two or three segments, mouth with a strong evertible underlip; in the dorsal blood-vessel a string-like organ of doubtful

*Exhibited before the Birmingham Natural History Society, on November 18th and December 9th, 1884.

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signification. Budding-zones in the abdominal region between every two segments. The whole nerve system in the epidermis.

"*C. pardalis:* Clap. Intestine, dark brown; in the skin numerous green drops. Amongst algæ and diatoms."

NAIS HAMATA.

This annelid, which is new to Great Britain, I found lately amongst a quantity of desmids and diatoms in a shallow ditch in Sutton Park, and I have more recently found associated with it *Nais lurida.* Both these were first discovered in Lower Franconia by R. Timm, and were figured and described by him in the Arbeiten Zool. Zoot. Inst. in Wurzburg, 1883. He describes the *Nais hamata* as follows:—

"The number of segments varies in a single individual between 20 and 30; body colourless, pellucid. Ventral bristles fine, generally two or three together. Dorsal bristles, begin in the fourth segment, reaching nearly three times as long as the thickness of the body, arched like a scimitar, furnished on the convex side with fine barbs, which are at least as long as the bristle is thick. In every bundle there are four to seven long and one to three shorter bristles. Tactile bristles (especially on the head), somewhat abundant. Brain not so distinctly divided into two lobes as in the other Naidina. Alimentary canal proportionately very large, with unusually strong, not interrupted, cell-layer. Muscular system extremely minute; whether a ring muscular layer is present, I cannot say; for the rest, it resembles that of the other Naidina. Both the blood-vessels have a considerable volume; their transverse section is mostly greater than that of the alimentary canal. I have only been able to see vessel-loops in the head segments, but it must not be understood that they are wanting in the remaining segments. Intestinal net distinct. The eyes, whose occurrence generally in the Naidina is very variable, are not always present. The extraordinarily thin epidermis thickens itself in the head and tail considerably, so that at both ends it forms a kind of cap. Length of each single animal, three to five mm.

"I have only found a few examples of this species in the act of budding, and then the zooids always holding together only in twos. Of these, the second was universally richer in segments than the first, while in the two-jointed chains of *Nais elinguis* I generally found the reverse condition."

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THE EAR AND HEARING.*

BY W. J. ABEL, B.A., F.R.M.S.

Sound may be described as the vibration of solids and fluids, propagated, by means of waves, through some intervening medium, to a specially prepared sentient surface. The function of the ear is to intercept and collect these undulations, and convey the result to the brain, by which organ they are made manifest to the individual as sound sensations. We may thus define the sensation of hearing as the conscious state resulting from the impinging, upon a specially prepared part of the sentient surface of the body, of aërial or other fluid vibrations, caused by the molecular disturbance of bodies in a state of tremor or vibration. Thus, in hearing, as in the other sensations, we take cognisance by the mind, not of the sonorous object, but of the condition of the auditory nerve; and all the ideas we form of sounds, as to their nature, intensity, direction, &c., must be based upon the changes which they produce in it.

The essential part of an organ of hearing is obviously a nerve endowed with the peculiar property of receiving and transmitting sonorous undulations.

Since all matter is capable of propagating sonorous vibrations, the simplest conditions must be sufficient for mere hearing, as all substances surrounding the auditory nerve can communicate sound vibrations to it. In the eye a certain disposition of parts is essential to cause the rays of light to impinge on the sentient surface with the same relative disposition as that which they held when they left the visible object; but in the ear, whenever and however sonorous undulations affect the nerve, they must cause a sensation of sound. It is, therefore, by no means indispensable, as some assert, that any specially modified surface should be included in the auditory apparatus, since the auditory nerve if merely in contact with any solid part—as the head—will be affected by the vibrations in which it is continually participating; and we are thus unable to assert that the sense is present only where we can discover a special organ.

The two modifications most constantly present in all auditory organs hitherto identified are—

I. A cavity wholly or partially filled with fluid, and lined with a membrane on which the nerve is distributed.

* Read before the Nottingham Naturalists' Society, February 17, 1885.

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II. A solid body, or bodies, of greater specific gravity than the surrounding substance.

The whole course of the development of the ear will be found to consist in a progressive series of adaptations for rendering more perfect the propagation of the sonorous vibrations, for their multiplication by resonance, and their more delicate discrimination.

The simplest form of ear hitherto identified is found in aquatic animals. It is marked only by the first of the two modifications noted above, and seems capable of receiving sonorous vibrations but imperfectly, and quite incapable of resolving them into tones. The next advance is marked by the addition of the second of the above modifications, thereby increasing the sensibility to vibratory influence. A still greater advance is the suspension of the whole sac in a more liquid material (the perilymph), followed successively by the evolution of an aperture, covered by a membrane upon which the external medium can at once act—the differentiation of the appendages of the vestibule, the cochlea, and, lastly, by the appearance of an external ear.

The lowest forms in which I am aware of the discovery of an ear are the *Medusidæ*, amongst the Coelenterates. In the edge of the umbrella of the common jelly fish (*Rhizostoma Pulmo*), the microscope, with a half-inch objective, shows small vesicles at the bases of the tentacles. In each of these vesicles may be seen a minute body, closely resembling a bell-clapper, suspended by a ligamentous neck, and vibrating about one hundred times a minute. These oval cells are thought to be the ears of the creature, and the solid particles contained in them to be otoliths (ear stones). In the next group—*Echinozoa*—I am not aware of the discovery of any auditory apparatus, although a true nervous system is present in the higher forms, amongst which eye spots are found (*e.g.*, some of the Entozoa and Rotifera).

Coming to the next sub-kingdom—*Annulosa*— we find that, although the sense of hearing in insects seems evident, little is known about their auditory apparatus. Ramdohr has placed it in the jaws, Strauss and Durckheim in the antennæ, De Blainville in the tracheal tubes on the sides of the body, and Agassiz in the legs. Professor von Graber finds what he terms "chordotonal sense organs" in the rod-like secretory structures of the nerves of various parts (chiefly legs or wings) of insects. He states that the general type of rod is pencil-like (scolopal), being pointed at its proximal end, and hollow, with extremely refractive walls. In some genera these rods are fastened to the integument by a special

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ligament, consisting of a thin-walled tube, continuous with the sheath of the nerve, and filled with a homogeneous and slightly granular mass. From an examination of upwards of sixty genera he gives as the most usual seat of the organ, the hind rudimentary wings (halteres) amongst the Diptera, next the fore wings, and, in the lower orders, the legs. He considers that in the Gryllidæ (grasshoppers) the tympanum and auditory meatus are both represented—the latter by the tracheal tubes, and the former by a peculiar enlargement of the trachea—whilst he identifies the above noted scolopophorous and other chordotonal nerve-endings with the organ of Corti (of which we shall treat shortly), and holds that the perception of auditory sensations is shared with the brain and head, by part of the ventral ganglia.

In the class *Arachnida*, exemplified by mites, spiders, and scorpions, F. Dahl considers that he has established, by experiment, the existence of a sense of hearing, which he localises in two kinds of hairs found on the legs and palps of these arthropods—(*a*) a hair of equal thickness throughout, fringed with a short pile near the apex, implanted in a cup-like depression, extremely mobile, and connected with a nerve at its base; and (*b*) a hair set in rows, and projecting outwards more than the ordinary protective hairs.

Some of the hairs on the claw-joints of scorpions are said by Dahl to have a like function; and the pits found by Haller in ticks (Ixodes) may possibly come under the same category.

Amongst the *Crustaceans* (cyclops, shrimps, lobsters, &c.), the ear consists of a small cavity excavated in the solid framework of the head. It may be easily found in the lobster or crayfish by examining the bases of the smaller antennæ (antennulæ). It is a little prominence of very hard shell, having a circular opening at the apex, across which is placed a thin membrane. Inside this is a sac filled with liquid, having the auditory nerve distributed over its inner surface, and containing one or more small bodies called otoliths.

Siebold was the first to notice the organs of hearing in the next sub-kingdon of invertebrates—the *Mollusca*. In the Lamellibranchiates (including mussels, oysters, cockles, &c.), they are situated in the foot, and consist of a large central ganglion, on each side of which is a minute cavity filled with the usual endolymph, and enclosing a small otolith. This otolith may be conveniently seen oscillating rapidly in the foot of the Cyclas, by using a half-inch objective.

In the Gastropods (snail, whelk, &c.), the ear is at the base of the tentacles. It consists of an auditory sac containing otoliths, which vary with the species.

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In the Cephalopods (sepia, cuttle, nautilus, &c.), the auditory sac is situated in the nervous ganglia at the base of the head. The first approach to a labyrinth makes its appearance in this class.

Ascending to the sub-kingdom, *Vertebrata*, we find the organ but little more complicated in the lowest order of fishes.

In the Cyclostome (round-mouthed sucker fishes, as the hag fish), the vestibule, represented by the sac amongst invertebrates, gives off a single annular passage, which may be considered as a semicircular canal, containing a few twigs of the auditory nerve. Amongst the higher Cyclostomes—as the lamprey—two such canals exist, whilst all other fish have three holding the same relation to each other as they do in man.

In the higher orders of fish, as just noted, we find the important addition of the labyrinth, consisting of three semicircular canals communicating with the vestibule, which, with the two ampullæ, formed by the expansion of the semicircular canals, give rise to three cavities at each side of the base of the brain. In each of these cavities is suspended an otolith, enclosed by the gelatinous endolymph, and enveloped by a thin membrane traversed in every direction by minute branches of the auditory nerve, forming an exquisite suspensory ligament. These otoliths are best studied in the skate, herring, sprat, mackerel, or salmon. They are calcareous concretions, pulverulent in the cartilaginous fishes (as the shark and ray), but hard and stony, and of a porcellanous appearance, in the osseous tribes.

Some rudiment of a tympanic cavity may be found in fishes, but there is no trace of a cochlea. In several of the species there is a connection between the labyrinth and the air bladder, made by a chain of bones, appearing to foreshadow the eustachian tube of the higher vertebrates. In the loach the air bladder is exceedingly small, extending under only two vertebræ, and is united with the head in this way. The skate has rudimentary external ears on the top of its head.

In the *Amphibia* (proteus, newt, frog, &c.), which are in many respects intermediate between the true reptiles and fishes, some species have a tympanum, whilst others, like fish, are destitute of it. Wherever the tympanum is distinct, there is also an eustachian tube connecting it with the fauces (top of throat).

The true Reptiles (turtles, snakes, lizards, and crocodiles) possess constantly a tympanic membrane and cavity containing a chain of bones. A rudimentary cochlea is also

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found (exemplified in the frog), not coiled as in mammals, but only slightly bent. There is, however, in the aquatic forms no external orifice, for, were the membrane exposed, as in mammals, sounds would be intolerable to the animals when in water. Abbé Nollet performed many experiments to prove this, which he reasoned should be owing to water being a better conductor of sonorous vibrations than air. Amongst other experiments, he struck together two pieces of metal or stone, whilst totally immersed in water, and found that the resulting sound sensations were painfully intense. Hence the drum in this class is completely covered with skin, and its position is only marked by a slight circular depression behind and a little below each eye. In these animals the otoliths appear to change their character. The stapeolus (the smallest of the three otoliths found on either side of the head of fish) here elongates into a trumpet-like body—the columella—whilst the other two otoliths on each side are much diminished, and become partly embedded in the fibres of the tympanic membrane. The expanded part of the columella forms a kind of disc closing the fenestra ovalis, which, like the fenestra rotunda, is found in the vestibule of reptiles.

Amongst Birds (*Aves*) the structure of the ear is essentially the same as in the higher reptiles. In birds, however, we notice a small external orifice, and, in some of the owl tribe, a rudimentary concha, or external ear. A distinct cochlea exists, resembling that in reptiles. It is divided into two passages by a membranous partition, on which the nerve is spread out. The tympanum, also, communicates with cavities in the cranial bones, which are thus filled with air, and, by increasing the extent of surface, would seem to produce a more powerful resonance.

(To be continued.)

THE LIAS MARLSTONE OF LEICESTERSHIRE AS A SOURCE OF IRON.

BY E. WILSON, F.G.S., CURATOR OF BRISTOL MUSEUM.

(Continued from page 97.)

The accompanying map (see Plate II.) shows the outcrop of the Marlstone Rock in the Leicestershire district. It is based on the lines of the Government Geological Survey, and is on the scale of $\frac{5}{28}$ of an inch to the mile. We may, I believe, take it as approximately correct; if not absolutely accurate, at every point. It must not, however, be imagined that this

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map gives a true idea of the area where the Rock-bed may be profitably worked for iron. In two distinct ways the Marlstone area shown on the map is very much larger, and in one way it is a little smaller, than the productive ironstone area met with in the field. In the first place the Marlstone Rock is, over a large portion of the district (namely, in the whole of the Rutland area, also south of Tilton and north of Caythorpe), *too thin* to work. In other places where it normally possesses a workable thickness, the whole or a large part of the upper or iron-bearing beds have been removed by denudation so that only the lower or unproductive arenaceous beds remain. This will be the case more particularly on the hill slopes. In some cases, too, the Marlstone may be covered with a thicker capping of boulder clay than it would pay to remove. For these reasons the Marlstone area is larger than the Ironstone area. On the other hand, where the prevailing dip carries the Marlstone Rock under newer formations, the ironstone, when present, may be followed for a short distance, until the "head" becomes too great and the rock gets too calcareous for profitable working. In these places, then, the Marlstone area delineated on the map may be somewhat smaller than the available Ironstone area. It should also be borne in mind that in the productive region the ironstone varies considerably in quality, its richness increasing apparently in proportion to the amount of atmospheric disintegration it has undergone, and the greater completeness with which oxidation of the iron carbonate and removal of the calcic carbonate have in consequence been carried.

After making all due allowance for the above causes of limitation and deterioration we cannot but be impressed with the vastness of the stores of iron which must be contained in this field. When we remember that the workable ironstone averages seven feet in thickness and covers many square miles of country, and that every acre yields 2,000 tons of ore per foot thick (or a total, say, of 12,000 tons of ore and 4,000 tons of metallic iron per acre), we see what an immense amount of mineral wealth is contained in the Marlstone Rock of the Leicestershire district. The proximity of this stone to a coalfield, viz., the Notts-Derbyshire, is also greatly in its favour, and enables this Lias ironstone to successfully compete with the somewhat richer but more distant Northamptonshire ore. It is impossible to do more than give a rough estimate of the total annual output of the Marlstone ore in the Leicestershire district. No complete mineral statistics are published for this field, and if there were they would not be reliable, seeing that new workings are constantly being opened out.

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At the present time there are four principal workings, viz., Holwell, Woolsthorpe, Eastwell, and Wartnaby, which each raise between 400 and 600 tons of ore daily, and four smaller ones, viz., Caythorpe, Tilton, Eaton, and Swaine's Lodge, which each get between 200 and 300 tons daily. This would make for the whole district a total of about 3,000 tons per diem, or 15,000 tons per week of five working days, and for the year, therefore, no less than 750,000 tons. The above estimate must not, however, be considered as anything more than a rough approximation of the truth, and is also liable to correction, as the output from some of the smaller workings is increased, and as new workings are from time to time opened out. There is an immediate prospect of such new workings, both on the Eastwell branch and on the extended Woolsthorpe branch, as well as at one or two other places in the district. In the course of the next two or three years the total annual output of iron ore in the Leicestershire district will, in all probability, exceed rather than fall short of a million tons.

The general method followed in working the ironstone is to drive a cutting for a considerable distance—from an eighth to half a mile—in a straight line, and to work along either one or both faces of the cutting. The soil, with the earthy débris of the top rubble, which is generally sifted out by using quarry-forks, is strewn over the rock-surface laid bare by the quarrying operations. The land thus restored is equal, and indeed superior, to what it was before the ironstone was removed, the shaking together of the particles of the somewhat too loose surface soil, and the addition thereto of the earthy débris of the underlying rubble, having a decidedly beneficial effect. We may frequently see good crops of corn or grass growing on the made-ground to within a few feet of the present working face. These ironstone workings do not then permanently injure, but rather improve the property of the fortunate landowners of the district.

The state of combination of the iron in the Marlstone ore is that of the hydrated oxide, or the same as in the very similar Northamptonshire ore of Oolitic age. It differs from that ore, however, in being essentially a calcareous instead of a siliceous stone. The Marlstone ore contains on an average from 30 to 33 per cent. of metallic iron. This percentage, though somewhat less than that of the Northamptonshire ore, is equal to the average percentage of the celebrated Cleveland ironstone, and distinctly superior to that of the Marlstone of Oxfordshire. The metal extracted from the marlstone of Leicestershire is said to be superior in quality to that obtained from the Northamptonshire ironstone.

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It is, however, found advantageous to mix a certain amount of the Northamptonshire stone with the Marlstone ore. The flux in general use is Derbyshire Limestone. Notwithstanding the large amount of water present, it is not usual to calcine the stone before putting it into the furnace. So far as the experiment has been at present tried, it is found that calcination, though it lessens the cost of manufacture, depreciates the quality of the metal, the furnaces tending to work hotter and make a more siliceous iron, which is not so highly valued in the market. For the purpose of comparison, I append a couple of analyses of the Marlstone ores of Leicestershire, the Cleveland district, and Oxfordshire, which may be taken as fairly representative of the quality of the stone in each instance. In reference to the Eastwell and Holwell ores, however, I wish to say that these analyses must not be taken as giving the relative richness of the ironstone at those two places, or, indeed, anything more than a rough idea of their general composition. The Marlstone ore varies so much in different beds, and in the same beds in short distances, that no two analyses, even in the same bed in the same quarry, would correspond. Hence, it is impossible from one or two analyses to determine the average percentage of this ironstone anywhere.

When unweathered, the Leicestershire Marlstone is very similar in appearance and has a very similar composition to the Cleveland ironstone, being a fine grained oolitic rock of a bluish-green colour, and containing the iron in the state of a carbonate. It also belongs to the same geological horizon (Middle Lias), and the two rocks may, therefore, be considered as approximately synchronous. In order to ascertain whether the percentage of iron in the unweathered marlstone of Leicestershire was such as to render it workable or otherwise, I have had two analyses of the Tilton stone made for me by Mr. G. F. Downar, analytical chemist, Bestwood, Notts. These analyses show that iron is present in the upper beds of the unweathered Marlstone Rock to the extent of from 25 to 30 per cent.—a percentage quite equal to that of certain beds which have been profitably worked in Cleveland and elsewhere, and falling but little short of the average percentage of the weathered marlstone ore of Leicestershire. It is not, however, to be supposed that it would pay to mine the unweathered ironstone in a district where the weathered rock covers many square miles of country, is of about equal thickness, has a better percentage of iron, and, being a much softer stone, and lying at the surface of the ground, and at a good altitude too, can be much more economically worked.

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A point of some interest that arises out of the consideration of the mineral character of the Marlstone Rock is the question of its coloration. Originally grey or greenish-blue, this rock becomes, when exposed to the prolonged action of the air (or of water containing oxygen), of a rusty brown colour; coincidently with this change in colour, the carbonate of iron becomes converted into the hydrated ferric oxide. There appears to be good deal of doubt as to what gives the grey tint to the unweathered stone. Dr. Sorby, with many others, supposes that the (bluish) green colour in this class of rocks is due to the presence of glauconite—an earthy mineral, having the composition of silicate of iron with some magnesia and water, and that the blue colour is given by the phosphate of iron. Prof. Judd, following Ebelman, holds that the blue colour in many oolitic limestones is due to a small quantity of sulphide of iron distributed through the rock mass, and ascribes the grey tint of the unweathered Northamptonshire ironstone, and therefore, also of the Leicestershire marlstone, to this substance. The green colour he ascribes to either the silicate or the phosphate of iron. The bisulphide of iron is certainly present in small quantity in the Tilton stone, but it seems rather difficult to understand how this material could give a blue colour to the rock. A small amount of the silicate of iron is present in the rock, and perhaps also a little phosphate of iron. The simplest explanation would be to ascribe the original grey colour of the marlstone to the carbonate of iron, a material which, as a chemical salt, is white, but becomes grey on exposure, or possibly to this and the phosphate of iron which gives a more pronounced grey tint. The green colour of the partially weathered marlstone may, I believe, be looked upon rather as a transitional stage from the blue to the brown stone, than as an original tint. I consider that it may be explained by the formation, in gradually increasing quantities, during exposure, of particles of the yellow hydrated ferric oxide, disseminated through the unaltered grey particles of the rock, just as by mixing blue and yellow pigments together we get a green tint.

(To be continued.)

RATS.—A gentleman saw repeatedly the singular spectacle of three rats running abreast over his grounds. Noting their track, and their usual times, he shot them, and then found that the middle rat was blind, and that all three held a straw in their mouths. It is almost too good to be true.—"Reminiscences," by Rev. T. Mozley, M.A. Vol. I., p. 115. (London: Longmans, 1885.)

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THE PRINCIPLES OF BIOLOGY.

BY HERBERT SPENCER.

EXPOSITION OF CHAPTER X.—GENESIS, HEREDITY, AND VARIATION.

BY W. B. GROVE, B.A.

This chapter is devoted to the final elaboration of the grand doctrine of physiological units (the plastides of some authors), by which Herbert Spencer tries to dissipate in some degree the mysterious phenomena of Genesis. We may make the preliminary remark that the mystery is, and cannot be, nay, is not intended to be, completely dissipated; the hypothesis only lends definiteness to our conceptions, and enables us to picture faintly to ourselves the mode of action. In this respect it resembles that other great doctrine of which it is an extension, the atomic theory itself; for after all we do not know (perhaps may never know) that atoms really exist; they are only mental representatives of something which does exist, and which, whatever its nature, obeys the same laws of combination and action which we feign for the atoms. It amounts to this—that Herbert Spencer's theory is true in fact, if not in form. It reduces the phenomena that we have been considering into their places in that vast reign of order, the slow, but sure, establishment of which is the object of scientific aims.

These phenomena may be represented in a formula:—

GENESIS = HOMOGENESIS (GAMOG.) + HETEROG. (GAMOG. + AGAMOG.)

and we have discovered that the latter part of the formula, agamogenesis interrupted by more or less frequently recurring gamogenesis, represents the more normal and frequent state of things. The question, when gamogenesis recurs, has been already answered; but why? Let us consider the facts from the beginning.

We suppose matter to be built up of atoms, which, by their combinations, give rise to molecules. These molecules are of gradually increasing complexity. We have the crystalloids, composed of few atoms, and comparatively stable; and the colloids, composed of many atoms, and comparatively unstable. The modern chemist is familiar with molecules consisting of hundreds of atoms, and we have no reason for supposing the process to end there. We may reasonably imagine these colloidal molecules to unite in molecules of a still higher order: these are the physiological units. It is known that as the number of unlike, but allied, atoms comprising the molecule increases, so in general does its

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instability, its susceptibility to external forces, and the number of its kinds. Illustrations are found in the fusible metals, which melt at a lower temperature than their constituents.

It is established in "First Principles" that any aggregate of molecules tends always towards equilibrium, and change cannot cease till equilibrium is reached. The aggregate acts upon the molecules in such a way as to cause them to tend towards certain positions; it is to this tendency that we apply the much-abused word "polarity." Its effect is seen in the growth of a crystal and the annealing of glass. If we imagine an aggregate of molecules of iron, for instance, unacted upon by external forces, they would exhibit a tendency, supposing them free to move, to place themselves all "heads and tails"; and we see instances of an approach to this state in the sometimes disastrous change which a wrought-iron bridge suffers when subject to continuous jar, and in the magnetisation of a bar of iron by hammering it while placed parallel to the terrestrial magnetic axis.

Now in the case of a growing organism we know how much greater and more rapid the changes are at first; the rate of change gradually diminishes, life becomes less active, the state of equilibrium draws nearer and nearer, and finally, when the molecules of the organism in certain parts cease to react to the stimulus of external forces, life has ceased, the organism is dead. The degree of activity of life is proportional to the susceptibility of the organic molecules, *i.e.*, the physiological units, to the action of the environment. "When therefore we see," as we have seen, "that gamogenesis recurs only when growth is decreasing or has come to an end, we must say that it recurs only when the organic units are approximating to equilibrium—only when their mutual restraints prevent them from readily changing their arrangements in obedience to incident forces."

We deduce then this result, that the use of gamogenesis lies in the necessity of overcoming this tendency to equilibrium and re-establishing the capacity for active molecular change, "a result which is effected by mixing the slightly-different physiological units of slightly-different individuals." The cells which unite have severally nearly reached a condition of equilibrium; this is shown by the fact that, if ununited, they are capable of only a little further growth. But though they are individually *in equilibrio*, yet, as they are derived from more or less unlike parts, the product of their union is not so; in fact, the slight unlikeness which exists is, as is known from inorganic chemistry, the very condition which ensures

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great instability, *i.e.*, in this case, great capacity for growth, in the product. Too great a difference is as ineffective as too little.

We know from the instance of Begonia that a single cell can contain within itself all the physiological units necessary for the reproduction of a species. Assuming then that the fertilised germ contains all the required units—derived jointly from both parents, and in a state suited for further growth—let us test the hypothesis by comparing it with established facts.

In the first place, Heredity and Variation become mere matters of course. The offspring cannot but resemble at the same time that it differs from its parents. Then the superiority of cross fertilisation to self-fertilisation is manifest in the greater unlikeness between the combining units which it ensures, and the consequent greater vitality of the offspring. Upon these, which are so fully treated in the original, it is not necessary to enlarge. Though self-fertilisation is not impossible, yet it is probable that it could not go on for ever; the species would in most cases die out. *A fortiori*, then agamogenesis could not go on for ever; yet as we have seen before, so far as our present knowledge extends, there seem to be cases in which no gamogenesis ever occurs. The cases of plants propagated, as it would appear, indefinitely by buds or cuttings or offsets, *e.g.*, the prolific banana, in which it is said no seeds have ever been produced within historic times, as well as those extremely numerous cases of fungi which were mentioned in a previous chapter, all show that the theory so far presented, though true, is not the whole truth.

We find agamogenesis prevailing the more the lower the type of the organism, the less differentiated its parts, the simpler and more uniform the conditions under which it lives; and this view is confirmed by observing that the only large class of plants in which no gamogenesis is known in any of its members is the lowest of all, the Bacteria. Hence it is obvious that the need for gamogenesis increases in proportion to the complexity of the forces which act upon the organism. Now, what causes a species to continue to live? Its fitness for its environment. If then this fitness can be easily maintained on the average, if the species exhibits no great tendency to vary in such a way as to unfit itself for its conditions of life, if in fact the forces which act upon it are not relatively complex, then it can maintain its position for long periods even by agamogenesis; but if the conditions are complex the individuals must be severally acted upon in different ways by their special environments, they must

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tend to vary so as to suit those environments, and be, "in so far, unfitted for the average habits proper to the species. But these undue specialisations are continually checked by gamogenesis." Thus the individual differences which would, if agamogenesis were the only means of multiplication available, be a bane, are by gamogenesis turned into a positive advantage. Any member of a class of organisms which had previously multiplied by agamogenesis would, if gamogenesis should become available to it, thereby get an advantage over its fellows and rise into higher society. Thus we can account for the fact that the gamogenetic act not only becomes more common as we rise in the organic scale, but also less incidental, and a more serious and regular part of the life-history of the species. We can trace it from its origin in what was a mere chance fusion of two individuals to the highly specialised form in which it occurs in the highest vertebrates.

But there is more than this, I think. It is a common truth that in agamogenetic modes of multiplication more individuals are produced than by gamogenesis. Therefore, if the species maintains its ground, more individuals must die, proportionately, in the former case than in the latter. Those that die must have been less fitted for the average life of the species; so also must their offspring be, if they produced any before death. But in gamogenesis, cross-fertilisation and to a less extent self-fertilisation neutralise that "fatal narrowness of adaption" which tends to arise, and, in so far, requires the production of fewer young to ensure the continuance of the species. This is another advantage of gamogenesis.

Finally, we must not suppose that this theory will explain everything. We must be content if it gives an intelligible reason for the cardinal facts and most of the details, leaving the apparent exceptions to be cleared up by future research.

THE PRE-CARBONIFEROUS FLOOR OF THE MIDLANDS.

BY W. JEROME HARRISON, F.G.S.

(Continued from page 104.)

9.—*The Longmynd Hills and the Stiper Stones.*—West of Church Stretton the Lower Cambrian rocks, striking north-east and south-west, occupy a breadth of six miles, rising in the Longmynd Hills to a height of 1,674 feet. They consist of grey, purple, or green grits, sandstones, slates, and conglomerates, whose thickness, unless they are repeated by

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strike-faults or folds, which, however, seems very probable, must be as much as 25,000 feet. We see neither the base nor the top of these beds, for they are bounded by great faults both on the east (near Church Stretton) and on the west. The western line of fault runs along the centre of the valley, which separates the Longmynd Hills from the ridge of the Stiper Stones. In this valley Dr. Callaway has recently detected numerous small bosses of Pre-Cambrian strata, of which Pontesford Hill occupies the largest area. Still walking westward we find the ascent to the Stiper Stones to be composed of the Shineton Shales. The Stiper Stones themselves are quartzose sandstones distinguishable lithologically, and by the fact that they contain an Arenig fauna, from the Wrekin quartzite. They may be regarded as forming the true base of the Silurian system, and are comparable with the *Gres Armoricain* of Brittany. They are overlaid by Arenig Shales, beyond which Upper Silurian rocks stretch westward into Wales.

10.—*The Malvern Hills.*—About thirty miles south-east of Church Stretton we find the Malvern Hills. They rise in conical masses from the plain of the Severn, being bounded on their eastern side by a fault of great magnitude. Gneissic and granitoid rocks form the core of the range, and are well exposed at the Herefordshire Beacon, Worcester Beacon, and North Hill. These are overlaid by indurated volcanic rocks, ashes, and hälleflintas, certainly belonging to the Pebidian division of the Pre-Cambrian era. Dr. Callaway has identified both these varieties of rocks in the Wrekin district.* The rocks exposed below the Quartzite at the Lickey, and at Hartshill, in all probability belong to the Pebidian formation, together with the entire series of the Charnwood rocks.

On the west side of the Malverns we find the Hollybush Sandstone resting upon the Pre-Cambrians (the Quartzite being absent), while above it are the Malvern Shales (comparable in part with those at Shineton and Stockingford). All the Lower Silurian strata are missing, but the Upper Silurians are in full force, the May Hill Sandstone forming their base, and they extend northwards to Abberley, and westwards until they disappear beneath the Old Red Sandstone.

II.—Borings which have reached the Pre-Carboniferous Rocks in the Midlands.—"Soundings on land," in search of either coal or water, have been executed at numerous points within the Midland Counties during the last few years.

* Quarterly Journal Geological Society, Vol. XXXVI., p. 536.

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Locality.	Lowest Mesozoic Formation found.	Palæozoic Formations reached.	Extreme depth attained.	Depth of Palæozoic Rocks below Sea-Level.
Netherfield, near Brighton	Middle Oolite ..	.. ..	1900	——
Caterham	Lower Greensand ..	.. ..	874	——
Richmond, Surrey	Trias	.. ..	1409	——
Crossness (near Blackwall)	Trias?	.. ..	1075	——
London (Tottenham Court Road)	Great Oolite (64ft.)..	Upper Devonian (red and green shales)	1134	980
N. London (Kentish Town)	Trias?	.. ..	1302	——
Turnford (near Cheshunt; 14 miles north of London)	Gault (164ft.) ..	Upper Devonian	950	835
Ware (6 miles north of Turnford)	Gault (160ft.) ..	Upper Silurian (Wenlock Shale).. ..	845	710
Gayton (5 miles S.W. of Northampton) ..	Trias (60ft.) ..	Lower Carboniferous	994	417
Northampton (Bridge Street)	Trias (54ft.) ..	.. ..	650	——
,, (Kettering Road; 1 mile N.E.)	Trias (67ft.) ..	Lower Carboniferous	851	527
,, (Kingsthorpe, 2½ miles N.E.)	Trias	.. ..	967	——
Orton (12 miles N.E. of Northampton) ..	Trias (24ft.) ..	Pre-Cambrian	789	341
Rugby	Trias (Waterstones)	.. ..	1145	——
Sapcote (near Hinckley)	Trias	Cambrian	1655	150?
Leicester, Spinney Hills, I.	Trias	.. ..	750	——
,, ,, ,, II.	Trias	Cambrian	819	450?
,, (near Evington)	Trias	Cambrian	1002	450?
Owthorpe (South Notts)	Trias (1,000ft.) ..	Coal-Measures	1066	900?
South Scarle (between Lincoln and Newark)	Permian (519ft.) ..	Coal-Measures	2029	1900?

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Thanks to the modern appliances by which such borings are executed, depths of from 800 to 2,000 feet have been readily reached; with the result that old rocks have been pierced at several points, and specimens in the form of "cores" brought to the surface.

The preceding list includes borings which have been made along a line extending nearly due north and south, from Scarle in Lincolnshire to Netherfield near Brighton. It shows in each case:— (1.) The lowest Mesozoic formation found; (2.) The Palæozoic formation upon which this Mesozoic rock rested (in those cases where the Palæozoic rocks were reached); (3.) the extreme depth to which the bore-hole descended; and (4.) the depth of the old Palæozoic surface below the present sea-level. Detailed sections of several of these deep borings have been already given by me in the pages of the "Midland Naturalist." *

Commencing on the south this chain of borings revealed an unexpected thickness of Oolitic strata below Sussex.

The Caterham boring disappointed those who hoped to obtain a water-supply for London from the *Lower Greensand*, which only a few miles further south is of considerable thickness. At Caterham this bed is only twenty feet thick, showing that we are quite close to its old shore-line, of which there are indications at its outcrop (round Sevenoaks) in the shape of numerous pebbles of quartzite and other hard rocks.

The Richmond boring showed below the Gault eighty-seven feet only of Oolitic strata, resting on red rocks (probably Triassic), in which the boring terminated. Under London only one boring has actually reached the Palæozoic axis, viz., that at Meux's Brewery in the Tottenham Court Road, where red and green Upper Devonian Shales were found to contain fossils of types such as occur in the Eifel district—*Spirifera Verneuilii* for instance. Mr. Whitaker† has pointed out that this strongly bears against the theory that the red beds at the bottom of the Kentish Town and the Crossness borings can be Old Red Sandstone, since in no known locality are the two types—the Devonian and the Old Red—found in such close proximity.

At Turnford the Gault rested upon purple Devonian Shales, and at Ware upon Upper Silurian (Wenlock) Shales. The four Northampton borings clearly proved the Trias there to

* Midland Naturalist, Vol. III., p. 188.

† Quarterly Journal Geological Society, Vol. XL., p. 724. Geology of London, p. 21.

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be very thin—a mere littoral accumulation, sixty or seventy feet in thickness—resting upon a degenerate representative of the Mountain Limestone, evidently also deposited close to an old coast-line. Some hard red marls and coarse grits and sandstones at the very bottom of the Gayton boring have been assigned to the Old Red Period, but it is more probable that they are Lower Carboniferous.

(To be continued.)

THE MIDDLE LIAS OF NORTHAMPTONSHIRE

CONSIDERED

1.—STRATIGRAPHICALLY.

2.—PALÆONTOLOGICALLY.

3.—AS A SOURCE OF BUILDING STONE, ROAD METAL AND IRONSTONE.

4.—AS A SOURCE OF WATER SUPPLY FOR TOWNS AND VILLAGES.

5.—AS A RECEPTACLE FOR WATER, WHEREBY FLOODS MAY BE MITIGATED.

BY BEEBY THOMPSON, F.C.S., F.G.S.

INTRODUCTION.

For several years the town of Northampton has had a very short supply of water, and yet during some portion of this period the district around has been subject to excessive and destructive floods. It is very commonly believed that excessive agricultural drainage is one of the chief causes of both these evils. My own ideas of the matter will be sufficiently explained later on, but it may be as well to state at once that the primary object of this treatise is to show that the Middle Lias of Northamptonshire, which is the chief water-bearing bed to the west and south-west of Northampton, offers considerable facilities for remedying the condition of things above referred to by one operation—that of artificially letting in to the porous beds of the district the water which is now largely kept out by natural and artificial means. This explanation will account for, and I hope excuse, the introduction of a section dealing with the springs of the county generally.

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PART I.

The Middle Lias of Northamptonshire considered Stratigraphically.

There is considerable difference of opinion amongst geologists as to the vertical limits of the Middle Lias, particularly downwards, so it is necessary for me at the outset to state explicitly what I consider to be Middle Lias in Northamptonshire, and my reason for claiming this and no other as belonging to the period in question.

To all who have studied the Lias deposits in England it must be evident that there was no great break in the continuity of the series at any time, and it is more than probable that, so far as the Lower and Middle Lias are concerned, a break at one place is represented by a continuous deposit at another. Such being the case, it appears to be only necessary to accurately state where the line is drawn in any locality by the local geologists. Professor Judd, in his "Geology of Rutland, &c.," places this matter, which is still one of controversy, in a very clear light; and I am sure I need offer no apology for quoting some of his remarks on the matter.

The Lias formations were first divided into "Upper," "Middle," and "Lower," by Phillips, in a book published in 1829:—"Illustrations of the Geology of Yorkshire." Part I., "The Yorkshire Coast."*

Louis Hunton was probably the first geologist who made the attempt to localise fossils, and so divide formations into zones characterised by a particular fauna; and a paper of his on this subject was published in Vol. V. of the second series of the "Geological Transactions," in 1836. This was followed by another paper in the same volume, by W. C. Williamson, which was an attempt to divide the whole of the Lias into zones.

Quenstedt, in 1843, divided the Lias into six stages, $\alpha\ \beta\ \gamma\ \delta\ \epsilon\ \zeta$. Dr. Albert Oppel, in 1856, published a work as the result of his study of the German and English Lias (chiefly Yorkshire, I think), in which Hunton's ideas of Palæontological zones was more completely developed; and since then this method of dividing the various formations, particularly the Lias and Oolites, has been largely followed.

* "The Yorkshire Lias," by Messrs. Tate and Blake.

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TABLE SHOWING THE DIVISION OF THE LIAS SYSTEM INTO ZONES.

† Divisions of Quenstedt.	† Continental Classification.	† English Geol. Survey.	* Zones adopted by Tate and Blake.	† Zones adopted by Judd.	* Zones adopted by Oppel (1856).	* Zones adopted by Wright (1860).
ζ	Upper Lias.	?	Zone of Ammonites jurensis.	Zone of A. jurensis.	Not recognised.	Upper Lias Sands.
ε		Upper Lias.	Zone of A. communis.	Zone of A. communis.	Zone of Posidonomya Bronnii.	Alum Shale.
			Zone of A. serpentinus.			
		Middle Lias.	Zone of A. annulatus.	Not recognised.		
δ	Middle Lias.		Zone of A. spinatus.	Zone of A. spinatus.	Zone of A. spinatus.	
			Upper Zone of A. margaritatus.	Zone of A. margaritatus.	Upper Zone of A. margaritatus.	
			Lower Zone of A. margaritatus.		Lower Zone of A. margaritatus.	
		Lower Lias.	Zone of A. capricornus.	Zone of A. capricornus.	Zone of A. Davæi.	
γ			Zone of A. Jamesoni.	Zones of A. ibex and A. Jamesoni.	Zones of A. ibex and A. Jamesoni.	Zone of A. Jamesoni.
			Region of A. armatus.	Zone of A. armatus.		
β	Lower Lias.		Zone of A. oxynotus.	Zone of A. oxynotus.	Zone of A. raricostatus.	Zone of A. raricostatus.
					Zone of A. oxynotus.	Zone of A. oxynotus.
				Zone of A. obtusus.	Zone of A. obtusus.	Zone of A. obtusus.
α			Upper Zone of A. Bucklandi.	Zone of A. semicostatus. (A geometricus. Oppel.)	Tuberculatus bed.	These divisions established on inference only.
			Middle and Lower Zone of A. Bucklandi.	Zone of A. Bucklandi.	Zone of A. Bucklandi.	
			Zone of A. angulatus.	Zone of A. angulatus.	Zone of A. angulatus.	
			Zone of A. planorbis.	Zone of A. planorbis.	Zone of A. planorbis.	

Quoted from "The Yorkshire Lias," by Messrs. Tate and Blake. † Quoted from "The Geology of Rutland," by Jno. W. Judd, F.G.S.

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This table to a large extent explains itself, but a few remarks on it are perhaps advisable; thus, taking the divisions of Quenstedt as a starting point, it appears that the Continental —particularly German—geologists, take the divisions α and β as Lower Lias, γ and δ as Middle, and ϵ and ζ as Upper, though some of the French geologists carry the Middle Lias lower down, and make it to include a good part of β. Each of these divisions may be justifiable in the district where it is adopted, but not so in others. The classification most commonly adopted in England is that which regards all the zones from that of *A. annulatus* to *A. armatus*, both inclusive, as Middle Lias; though in the English Geological Survey they draw the line between the zones of *A. margaritatus* and *A. capricornus;* and Mr. R. Tate, in a paper in the "Journal of the Geological Society" for August, 1870,* has given reasons for drawing the line of demarcation between the zones of *A. obtusus* and *A. oxynotus*. Mr. Tate's reasons are entirely palæontological, and are based on a study of the Gloucestershire Lias in the Cheltenham district.

So far as Northamptonshire is concerned there seems to me little doubt that the divisions adopted by the Geological Survey are justifiable for the following reasons, which also hold good in most of the North Midland counties.†

1.—There is a very marked change in the mineral character of the beds when the zone of *Ammonites margaritatus* is entered, sands, sandy shales, and ferruginous limestones being met with instead of clays.

2.—The division is quite defensible on palæontological grounds, for the ammonites of the group of the Capricorni disappear entirely and are replaced by the Amalthei group.

3.—Very much confusion and ambiguity is saved, and the mapping of the district much facilitated, by drawing the line of demarcation between a set of sands and clay, for not only are they more easily distinguished in a section but the line of division is often sharply indicated by a line of springs; whilst it is almost impossible to draw a line of boundary in the midst of a series of clays of almost uniform character, like those composing the beds below this division.

Whether the classification adopted by the English Geological Survey is best or not for general purposes it is certainly the best for use here, because it gives almost exactly

* "On the Palæontology of the Junction Beds of the Lower and Middle Lias of Gloucestershire," by Ralph Tate, Esq., Assoc. Lin. Soc., F.G.S., &c.

† See "The Geology of Rutland," by Jno. W. Judd, F.G.S. Introductory Essay.

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the limits of the set of beds I intend to describe under the head of the Middle Lias, though a term such as "Upper Middle Lias" might be preferable, and is indeed at times used.

There is not much difficulty in fixing the upward limit of the Middle Lias, although what I shall in this paper call the Transition Bed has been variously named, and variously classed, and sometimes ignored. Mr. Day* calls this bed the *Pleurotomaria Bed*, as it exists in Dorsetshire. In Yorkshire its equivalent has been described by Messrs. Tate and Blake, under the name of the Zone of *Ammonites annulatus*, and in the Midland Counties we commonly call it the *Transition Bed*, a name first used by Mr. E. A. Walford, F.G.S.† There is a decided mixing of Middle and Upper Lias fossils, and the ammonites in this bed are almost entirely Upper Lias; nevertheless there is such a large preponderance of Middle Lias fossils that there is scarcely a doubt as to where it should be placed. I have between ninety and a hundred species from this bed in Northamptonshire, and I believe quite three-fourths of them would be regarded as Middle Lias.

(To be continued.)

METEOROLOGICAL NOTES.—March, 1885.

The barometer experienced several fluctuations during the month, and some of the changes of pressure were both sudden and rapid. On the 14th the reading was 30·630 inches at Loughborough, at 8 a.m., its highest point. Temperature was below the average, the mean being 2·4° less than that of February; the range was smaller than usual for the time of year. The highest maxima were 60·0° at Henley-in-Arden, on the 20th; 58·4° at Hodsock, 53·7° at Strelley, and 53·5 at Coston Rectory, on the 17th; and 55·5° at Loughborough, on the 28th. In March, 1884, the highest maximum at Loughborough was 69·1°. In the rays of the sun 117·1° was registered at Hodsock, and 101·2° at Strelley, on the 17th; and 105·8° at Loughborough, on the 27th. The lowest minimum readings were 22·5° at Coston Rectory, on the 24th; 23·5° at Hodsock, on the 2nd; 24·4° at Loughborough, on the 15th; 26·0° at Henley-in-Arden, on the 15th; and 28·0° at Strelley, on the 2nd and 23rd. On the grass, the thermometer recorded 17·3° at Hodsock, 18·1° at Strelley, and 20·2° at Loughborough, on the 23rd. The rainfall was below the average, the

* "On the Middle and Upper Lias of the Dorsetshire Coast," by E. C. H. Day, Esq., "Quarterly Journal of the Geological Society," August, 1863.

† "On Some Middle and Upper Lias Beds in the Neighbourhood of Banbury," by Edwin A. Walford; "Proceedings of the Warwickshire Naturalists' and Archæologists' Field Club," 1878.

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total values being 1·21 inches at Strelley and Henley-in-Arden, 1·06 at Hodsock, 0·83 at Loughborough, and 0·79 at Coston Rectory. The greatest fall occurred at each station on the 3rd, and the number of "rainy days" ranged from 11 to 15. The greater portion of the rain fell in the earlier days of the month, so that vegetation was not sufficiently advanced to suffer much injury from the frequency of radiation frosts. Snow fell on the 6th, 18th, 20th, and 21st. Sunshine was deficient. The wind varied in direction, and was not of so much force as is customary in March. The dry nature of the soil was highly advantageous for farming operations.

Wm. Berridge, F. R. Met. Soc.

12, Victoria Street, Loughborough.

Natural History Notes.

The Midland Union.—The following arrangements for the Annual Meeting in June are nearly completed:—on the morning of June 16th, the Committee will meet in the Council Chamber at the Council House; in the afternoon the General Meeting will be held in the Examination Hall at the Mason College; and in the evening there will be a Soirée in the Town Hall, when the electric light will be used for illumination instead of gas. On the 17th, there will be three excursions; one to Kinver and Enville, one to Cannock Chase, and one to Bromsgrove Lickey. The reception room will be in the Library of the Birmingham Natural History and Microscopical Society in the Mason College. We hope to see delegates and friends from all the Societies in the Union.

British Association.—Arrangements as to the accommodation of the British Association in Aberdeen at its meeting in September are now being finally made, in consonance with the suggestions of Professor Bonney in April last. In addition to £2,000 obtained by personal application, other sums have been received for the guarantee fund, in answer to a circular recently issued. It has been arranged that the Artists' Society shall hold its exhibition during the session of the Association, instead of in the summer months, and that it shall be open free to members of the Association; natural history and archæological exhibitions have also been proposed, as well as a project for establishing telephonic connection between the various halls placed at the disposal of members.

Hermaphroditism of Germigenal Cells.—The development of ova and spermatozoa has of late years formed the subject of many elaborate researches, the latest of which by E. Van Beneden is full of importance and interest. The phenomenon of the separation of polar vesicles from the ovum has been regarded by some authorities, including the late Professor Balfour, of Cambridge, as simply a case of cell-division, and by others as the exclusion of the male element from the originally hermaphrodite ovarian cell. Since the phenomenon does not occur in cases of Parthenogenesis the latter theory seem very probable; but, on the other hand, the obvious question is whether any similar exclusion of a female element from the spermatozoon takes place, and hitherto no satisfactory instance has been given. In his last paper, Van Beneden, who is a strong upholder of this theory, states that the male germigenal cell before its development into spermatozoa throws off a globule which he regards as the female element of the nucleus. We shall await with interest the confirmation or disproof of this remarkable statement.

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"A Warning from the British Coal-Fields" is the title of a pamphlet published in Liverpool, which advocates the formation of a national association, the purpose of which should be to inquire into the exhaustion of our coal. At the present rate the author thinks British coal will come to an end in 110 years. It is to be regretted that such an alarming statement should be made except on the most trustworthy authority. We call attention to this pamphlet mainly to remind our readers that the Royal Coal Commission, whose report was published in 1871, gave nearly 450 years for the duration of the coal to the depth of 4,000 feet. In the zone exceeding that limit a quantity of coal which amounts to 48,465,000,000 tons is believed to exist.

Eyes on Shells. — Professor Moseley has lately discovered the presence of eyes on the shells of certain Chitonidæ. They are restricted to the exposed areas of the outer surfaces of the shells—that is, to the *tegmenta* of Carpenter. Each eye lies in a pear-shaped pit, which is covered externally by a calcareous cornea. The cavity of the pit is lined by a dark brown pigmented substance, which curves inwards beneath the cornea, forming a sort of iris. The lens, which is perfectly transparent, hyaline, and strongly bi-convex, lies behind the iris aperture. The fibres of the optic nerve, within the pigmented cavity, become separated from one another and loose, and pass directly to a retina composed of a single layer of short well-defined rods. The absence of eyes has hitherto been regarded as a characteristic of the Chitonidæ, and the ignorance of their existence is, perhaps, due to the fact that they do not occur in any common European representative; they are not easily seen in dried specimens of shells, which require to be moistened with spirit before the eyes become visible; and Schizochiton, in which they are largest and most evident, is a rarity in museums.

Coloured Sounds.—It is said that the blast of a trumpet has been compared to scarlet, and a serious dissertation has been written on the problem "Of what colour is A flat." But, joking apart, the phenomenon of coloured hearing has now a recognised scientific place. In "La Nature," April 18th, 1885, M. de Rochas gives an account of several observations which have been made on the subjective colours associated with sounds in certain persons. A man examined by Dr. Pedrono, of Nantes, perceived a different colour for each musical note; neighbouring notes produced similar colours: the high notes were accompanied by brilliant colours and the low by sombre ones. A musical chord produced a single colour, the resultant of those due to the separate notes; if the chord contained a dissonance, the colour proper to that appeared as a detached patch near to the other. Human voices appeared coloured according to their *timbre;* yellow, red, green, and blue voices could be distinguished, the blue voices being the commonest; green voices were very rare. An Italian, Doctor Z., examined by M. Ughetti, attached different colours to different vowels; thus *a* was black, *é* yellow, *i* red, *o* white, and *ou* coffee-coloured (the vowels of course bearing their continental pronunciation.) In conversation the rapid succession of vowels generally prevented the Doctor from perceiving the colour due to each; but if a word contained the same vowel several times repeated then the colour became distinct; thus *ballata* was black, *nêvé* yellow. Other similar cases, differing, however, in their details, are known, and M. de Rochas promises to describe one which he has himself met with, still more interesting than those now given.

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Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Geological Section. March 24th. T. H. Waller, Esq., in the chair. Exhibits:—1. Mr. J. E. Bagnall. A number of mosses from near Stockingford, including *Hypnum molluscum*, *H. chrysophyllum*, *H. pumilum*, *Tortula spadicea*, *Fissidens tamarindifolius*, &c. 2. Mr. T. H. Waller. The following sections:—(*a*) Red vein in Rowley Rag, showing radiating zeolite; (*b*) Rowley Rag, showing parallel arrangement of plates of ilmenite; (*c*) Very coarse Rowley Rag, showing large quantities of apatite; (*d*) Rowley Rag from Tansley Hill, showing microporphyritic structure and fluidal arrangement; (*e*) Grey vein in Rowley Rag, showing long blade-like crystals of orthoclase; (*f*) Grey vein in Rowley Rag, showing inclusions in the glassy base; (*g*) Rowley Rag from Hailstone Hill, showing olivine; (*h*) Rowley Rag from Tansley Hill, Dudley, showing microporphyritic structure. Mr. Allport then took the chair, while Mr. Waller read his paper, entitled "Some recent observations on the structure of Rowley Rag." After the paper, a very interesting discussion ensued. Mr. Waller congratulated the section on once more having Mr. Allport in the chair. —General Meeting. March 31st. Mr. James Mathews, Clent, sent for exhibition *Thuja occidentalis* covered with blossom. Mr. W. B. Grove, B.A., exhibited the following fungi:—*Schizophyllum commune* and *Œcidium grossulariæ*, collected by Mr. W. H. Wilkinson in America; also *Œc. phlogis*, *Œc. podophyllatum*, *Œc. convallariæ*, *Œc. porosum* and *Hypocrea citrina*, all from Iowa, U.S.A.; *Sphærella pinodes*, from Ireland; also from this neighbourhood *Helmint hosporium cylindricum*, *Hyalopus ater*, *Acrothecium tenebrosum* (all three new to Britain), *Hypomyces candicans* (very rare), and *Entyloma ranunculi*. Mr. W. H. Wilkinson read his paper on the "Flora of N. America," and exhibited 85 sheets of specimens collected, containing nearly 150 different species, including many curious and interesting plants. Mr. T. Bolton exhibited living specimens of *Balanus balanoides*, also the larval (Narplius) form, under the aquarium microscope.—Sociological Section. April 2nd. At this meeting Mr. F. J. Cullis tendered his resignation as hon. secretary, in consequence of the pressure of his engagements. It was unanimously resolved that the best thanks of the section be presented to Mr. Cullis for the able and courteous manner in which he has fulfilled the duties of the office. Mr. Alfred Browett was unanimously appointed as his successor. Mr. Browett then read, with illustrative comments, Chapter III. of Mr. Herbert Spencer's *Study of Sociology*, "Nature of the Social Science," upon which an interesting discussion followed. A suggestion that a second excursion should be made to George Eliot's Country early in June next met with approval. —Biological Section. April 14th. Mr. R. W. Chase in the chair. Mr. T. Bolton exhibited the larval form of the common fresh-water mussel, *Anodon cygneus;* the rose beetle, *Cetonia aurata*, sent by Mr. Sylvanus Wilkins, and discovered in an old thatched roof near Lyme Regis; and also one of the Jungermanniæ, *Pellia epiphylla*, from Sutton Park. Mr. J. Levick, a fine gathering of *Volvox globator* and *Argulus foliaceus*. Mr. W. H. Wilkinson, *Helleborus viridis*, *Hepatica trilobata*, *Omphalodes verna*, and a lichen (*Peltigera canina*) in fine fruit, all from Blockley, Worcestershire. Mr. J. E. Bagnall, *Webera carnea*, *Eurhynchium piliferum*, *Hypnum cordifolium*, and other mosses from the Anker district. The Rev. H. Boyden then read a paper, "Natural History Rambles in the Neighbourhood of Llandudno." Having first given a

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very interesting and humorous description of the various scenes and episodes to be noted by the observant visitor to such places during the tripping season, he then passed on to notice some of the geological features of the district, then the seaweeds and corallines, mosses and flowering plants, illustrating his remarks by a fine and beautifully prepared collection of the various objects; among the more rare were *Trollius Europœus*, *Helianthemum canum*, *Frankenia lævis*, *Geranium sanguineum*, *Erodium maritimum*, *Spiræa Filipendula*, and many others. A discussion followed, in which Messrs. R. W. Chase, J. E. Bagnall, W. B. Grove, J. Morley, and W. H. Wilkinson took part. Mr. Boyden also presented to the library of the Society a carefully prepared MS. list of over 250 flowering plants noticed in the Llandudno district.—MICROSCOPICAL GENERAL MEETING. April 21st. Mr. W. P. Marshall, M.I.C.E., explained the new process of continuous section cutting, the apparatus for which he described from a diagram, and illustrated it by the exhibition of a series of twenty-nine slides with eight hundred sections of the Pennatulida, prepared by Dr. A. M. Marshall and himself. The slides were shown under about a dozen microscopes, and the members were much interested and pleased with the very successful results. Mr. Frederick Fitch, F.R.M.S., exhibited a series of exquisitely mounted specimens of dissections, showing the anatomy of the earwig, snout fly, &c., which he had prepared himself. Mr. W. H. Wilkinson exhibited three lichens, finely in fruit, from Blockley, viz., *Physcia ciliaris* var. *actinota*, *Evernia prunastri*, and *Parmelia physodes*. Although the two latter are amongst our commonest tree lichens they are very rarely found in fruit.—SOCIOLOGICAL SECTION. April 16th. The President, Mr. W. R. Hughes, F.L.S., in the chair. Mr. W. H. France read a paper on Chapters VIII., IX., X., of part 3, of Mr. Herbert Spencer's *Principles of Biology*, "How is Organic Evolution Caused?" "External Factors," "Internal Factors." Speeches upon the subjects treated were delivered by the President, Dr. Hiepe, Mr. F. A. Walton, and Miss Naden, and a generally interesting discussion followed, in which all the members present took part.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—March 23rd. Mr. Insley exhibited remains of fossil fish from the Lower Lias formation of Lyme Regis. Mr. Tylar described the use of osmic acid in the preparation of microscopic objects, and showed a number of slides of entomostraca, &c., prepared by it that retained a life-like appearance. Mr. J. W. Neville showed, under the microscope, *Carchesium polypinum*.—March 30th. Mr. H. Hawkes exhibited a male specimen of the four-horned spider crab, *Pisa tetraodon*; Mr. Madison, specimens of *Zonites radiatulus*; Mr. F. Shrive, two living adders taken a few days previously in Sutton Park. Under the microscope, Mr. Tylar showed a section of coralline limestone, and also one of pentacrinite from Lyme Regis. Mr. Moore, palate of slug, *Testacella haliotoidea*; Mr. H. Hawkes, *Batrachospermum moniliforme*, showing oospores; Mr. Insley, fossil polyzoa, from the mountain limestone.—April 13th. Mr. J. W. Neville showed a collection of marine algæ from Weymouth; Mr. Madison, leaf impressions from Tertiary beds, near Bournemouth; Mr. Sanderson, specimens of *Jungermannia bidentata*. Under the microscope, Mr. Moore showed stomach of green saw-fly, containing pollen and insect remains; Mr. Tylar, *Hydra vulgaris*, greatly distended through swallowing a phantom larva; Mr. H. Hawkes, *Epistylis grandis*, and *Vorticella nebulifera*; Mr. Grew, operculum of *Cyclostoma elegans*. Mr. J. Betteridge presented to the Society, as a first instalment, nineteen specimens of birds preserved

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and set for the cabinet, in illustration of his series of papers on "The Birds of the District," recently read before the Society. They included, among the less common birds, specimens of the golden-crested wren, *Regulus cristatus;* great titmouse, *Parus major*; Kingfisher, *Alcedo ispida*; and great crested grebe, *Podiceps cristatus*. A hearty vote of thanks was accorded to Mr. Betteridge for his kind gift and his zealous labours in popularising ornithology. Mr. Betteridge replied, and intimated that the second instalment, including many of our summer visitors, would be ready in the early part of July.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY.—SECTION D, ZOOLOGY AND BOTANY. Chairman, F. T. Mott, F.R.G.S.—Monthly meeting, April 15th, attendance nine (two ladies). Exhibits: *Pellia epiphylla*, in fruit, one of the larger hepaticæ, by Mr. Quilter. Cells of the common wall bee, *Osmia rufa*, taken from an old mud wall, containing pupæ in two stages, some in which the larvæ were only just enclosed, others in which the perfect insect was ready to emerge, and from one of which, on being broken, the live bee escaped and crept about, its wings being not yet dry enough for flight; also several Coleopterous and Dipterous larvæ found in a ball of bee-bread in another cell, and a number of mites from an empty cell, where they appeared to be feeding on the propolis with which it was lined, by Mr. W. A. Vice. Several numbers of the periodical Cole's "Microscopical Science," containing finely executed coloured figures of microscopic objects, accompanied by slides, by Mr. W. E. Grundy; Dumortier's "Hepaticæ Europæ," with coloured plates, price 10s.; and Watson's "Topographical Botany," price 16s.; also a square of compressed camphor, very suitable for use in cabinets and herbaria, by the chairman. Paper "On the *Ricciaceæ*," by the chairman, illustrated by specimens, and a coloured drawing of *Riccia glauca*, recently collected from a shady bed in his garden at Birstal Hill. This species had not hitherto been recorded in Leicestershire, although it was perhaps the one referred to in Coleman's list under the name of *R. crystallina*. The fruit of these abnormal Hepaticæ was particularly curious and interesting, each of the hard black spores being shaped like the fourth part of a sphere, rounded on one side and pyramidal on the other.

THE CARADOC FIELD CLUB.—The annual meeting of this Club was held at Shrewsbury, March 19th, the Rev. J. D. La Touche, president, in the chair. After re-electing the officers and transacting the other ordinary business of the club, the following programme for the coming season was fixed upon:—Tuesday, May 19th, Titterstone Clee Hill; Wednesday, June 17th, Bishop's Castle, for the Bishop's Moat and Offa's Dyke; Tuesday to Thursday, September 28-30, to Cader Idris, North Wales; Friday, October 9th (subject to alteration), Pontesford Hill and Abberley Valley. This last meeting has for its special object the study of cryptogamic botany. The Club has made it a practice for some years past to offer prizes to the children in the National Schools in the county, up to fourteen years of age, for the best collections of fossils, wild flowers, and insects. Three competitors appeared with collections of fossils, each of which was considered worthy of a prize. These collections were purchased by the Club and presented to the Shrewsbury Free Museum. The completion and publication of "A Handbook to the Geology of Shropshire," by the President, to the cost of which a grant had been made from the funds of the Club, was a subject of warm congratulation, especially as the sale of the work had already been so large as to secure its financial success.

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ON THE INTERCELLULAR RELATIONS OF PROTOPLASTS.—IV.

BY WILLIAM HILLHOUSE, M.A., F.L.S., ETC.

(*Continued from Vol. VII., p. 126.*)

Having at times probably a genetic relationship with sieve tubes are the articulated latex vessels, an interesting memoir on which was published in 1882 by D. H. Scott.* Dippel† had believed the resemblance to be sometimes carried to the extent of the presence of sieve-like perforations in the septa, as in *Chelidonium* and *Papaver*, and of actual lateral sieve-plates in the same genera, thus producing intermediate structures between sieve tubes and latex vessels. It must, however, be borne in mind that the conception of a sieve plate has greatly developed since 1863. A sieve plate, as has been fully noted earlier in this paper, has special structure besides its mere sieve-like perforation; and while it is quite true that the septa of latex vessels are often perforate, and that not merely by one, but often by a group of perforations, they are large in size, irregular in outline, and altogether devoid of callus.

Thus far, therefore, sieve tubes must be regarded as the only structures in which any approach to protoplasmic continuity (not bodily) had been universally recognised; and even with these it must be especially remembered that the protoplasmic threads connecting the contents of the adjoining cells constituting the tubes are products of protoplasmic activity, and are not relics of initial unity. They are the last term of a series of resorption phenomena which manifest themselves in so many stages of vegetable development—the fusion of the conjugating canals in Zygnemaceæ and Mucorinæ, the union of rows of cells into vessels and ducts, the anastomosis of cells in a latex system, the peculiar wood cells of the mistletoe (*Viscum album*).

It remained for Tangl‡ to open up, in 1879, a new vista of possibilities in a memoir, in which he demonstrated the

* D. H. Scott, B.A., "The Development of Articulated Laticiferous vessels," Q. Journ. Mic. Sc., 1882, pp. 136—153 and 1 plate.

† Dippel, "Entstehung der Milchsaftgefässe," Verhandl. d. Bataafsch. Genootschap, &c., te Rotterdam, tom. XII., p. 3 (1863).

‡ Tangl, "Ueber offenen Communicationen zwischen den Zellen des Endosperms einiger Samen." Pringsheim's Jahrbücher f. wiss. Bot. XII., pp. 170—190, and plates 4—6.

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existence of open communication between neighbouring cells in the endosperm of the seeds of certain palms—*Strychnos nux-vomica*, *Areca oleracea*, and *Phœnix dactylifera*. As this investigation of Tangl's, although describing what for some years appeared to be isolated phenomena, is still the starting point of recent research in this direction, we will give to it brief special attention.

The endosperm of *Strychnos nux-vomica* is bounded outwardly by layers of cells elongated at right angles to the surface, and therefore shown best in a section taken in this direction. The inner tissue of the endosperm, shown by sections taken parallel with the surface of the seed, and at some little distance below that surface, consists of thick walled cells, with strongly-swelling membranes. Under the influence even of water these membranes swell very greatly, and show strongly-marked lamination. If a dried section of this inner endosperm tissue is allowed to swell in dilute alcohol the lamination of the membrane is manifest, and at the same time a fine cross striation is seen in the walls of adjoining cells. But if a section of this same portion of the endosperm is treated with potassium iodide iodine, these striæ stain yellow or brown, and show as "fine threads penetrating the cell walls in their entire thickness" (see fig. 7).* For reasons derived from the relations of these striæ towards colour re-agents, Tangl came to the conclusion that the striæ were none other than delicate prolongations of the outer layer of the cell protoplasm penetrating the cell walls and communicating with one another. They are not visible in the dry state, nor in absolute alcohol, from the close relationship of their refractive index with that of the surrounding cell membrane. By absorption of water these refractive indices are changed in unlike degree, so that the threads show out in the laminated membrane with a greater or less degree of clearness, just as the lamination itself of the membrane shows for the same reason.

The endosperm of *Areca oleracea*, examined by means of sections taken parallel with the surface of the seed, and swollen in water, shows walls of considerable thickness and homogeneous structure, with local thin areas, corresponding in position in adjoining cells, but presenting no structural peculiarities. If, however, similar sections are allowed to swell in chlorzinc iodine ("Schultz's solution") until the cell-walls have taken a uniform blue coloration, it will then

* The figures illustrating this portion of the paper will be published in connection with a future instalment.

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be seen that the middle lamella, separating the widened bases of the pits in adjoining walls, is penetrated by fine threads passing from pit to pit (see Fig. 8). While the more median of these threads appear to pass in a straight line from pit to pit, the lateral ones are progressively more and more curved, so as to make the figure described by the outermost elliptic, or even almost circular. (The same relations are visible in the threads passing through the normal thick parts of the walls in *Strychnos nux-vomica*.) The threads are brought out with still greater clearness when, prior to treatment with chlorzinc iodine, the section has been laid in potassium iodide iodine.

In *Phœnix dactylifera* sections of the endosperm taken parallel to the surface of the seed, as well as at right angles with it, first saturated with potassium iodide iodine solution, and then allowed to swell in chlorzinc iodine, show a structure analogous if not similar. The thickened walls of the cells show numerous strongly-marked pits, corresponding in position in adjoining walls. The unthickened wall separating the bases of the pits, stained feebly yellow, is seen clearly to be pierced by dark yellow or brownish rods. These rods, likewise, are protoplasmic in nature.

It will be seen, therefore, that Tangl claimed to have found in these seeds evidence of protoplasmic continuity of a clear kind. In *Strychnos nux-vomica* the protoplasmic threads pass through the thickened wall at, practically, any point of its periphery, excepting perhaps at the actual angles of the cells, and are of extreme tenuity; while in the case of *Areca oleracea* and *Phœnix dactylifera* the threads are somewhat coarser, in the latter notably so, and pass only through the unthickened parts of the cell wall, *i.e.* through the closing membrane of the pits.

While carefully guarding himself against the suggestion of the general occurrence of such protoplasmic threads even in the group of palms, Tangl closes his memoir with the following important sentences:—

"Ueberblicken wir die gewonnenen, in der vorliegenden Abhandlung niedergelegte Resultate der Untersuchung, so wird durch dieselben die Thatsache festgestellt, dass die verdickten Membranen des Endosperms einiger Samen von einem System von Verbindungskanälen durchzogen werden, durch welche eine offene Communication zwischen benachbarten Zell-elementen und ein continuirlicher Zusammenhang ihrer Protoplasma-körper hergestellt wird.

Der Umstand, das die Darstellung des beschriebenen Baues in den verdickten Membranen des Endosperms in systematischer Beziehung sehr weit abstehender Pflanzen gelungen ist, darf der Hoffnung berechtigen, dass wir demselben auch noch bei anderen Objecten begegnen werden."

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This "open communication between neighbouring cell-elements" and "continuity of their protoplasmic body," which Prof. Tangl ventured to hope would be found in objects other than those in which he describes it, has in the last three years been shown to exist in such widely-different plants and parts of plants as to lend foundation to a broader hypothesis of the protoplasmic unity of the entire vegetal organism.

(To be continued).

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.C.S., F.G.S.

PART I.

(Continued from page 139.)

The parts of the Lias then that I am about to describe include the following divisions:—

1.—THE TRANSITION BED.
2.—THE ZONE OF AMMONITES SPINATUS.
3.—THE ZONE OF AMMONITES MARGARITATUS.

These divisions include twelve distinct beds, six of them being fairly hard and six soft. Below is what may be regarded as a typical section for the county, or perhaps I should say the west and south-western parts of the county, for there only can all these beds be seen.

TYPICAL SECTION OF THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

	Aver. thickness. Ft.	In.
"TRANSITION" BED.		
A.—Soft grey marl, or stone, passing upwards into red sandy clay, containing *Ammonites acutus* and small *gasteropods* in great abundance	0	6
"SPINATUS" ZONE.		
B.—Rock bed.—A calcareous and ferruginous rock, containing *Rhynchonella tetrahedra*, *Terebratula punctata*, *Pecten æquivalvis*, and large *Belemnites*, all in great abundance	6	0
Springs nearly always met with.		
C.—Marly clay, containing concretionary ferruginous nodules	2	0

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D.—Soft sandy limestone, often shaly in character, abounding in fossils, the most common being *Pecten liasinus*, *Protocardium truncatum*, *Astarte*, &c. 3 0

E.—Sandy or marly clay ... ... 2½ft. to 8 0

"MARGARITATUS" ZONE.

F.—Soft sandy and ferruginous limestone, generally shaly; very fossiliferous. The following rather abundant:—*Ammonites margaritatus*, *Protocardium truncatum*, *Pholadomya ambigua*, *Pleuromya costata* 3 0

G.—Sandy marl or clay, micaceous and ferruginous; *Ammonites margaritatus*, &c. 6 0

H.—Soft sandy limestone, abounding in fossils, very ferruginous, containing *Ammonites margaritatus*, *Pholadomya ambigua*, *Protocardium truncatum*, *Avicula inæquivalvis*, *Modiola*, &c. 3 0

I.—Sandy micaceous clay, very soft and friable ... 4 0

J.—Micaceous and calcareous sandstone; *Protocardium truncatum*, *Pecten liasinus*, *Fucoid markings*, all abundant 2 6

K.—Sandy, micaceous, and ferruginous shale or clay, abounding in fossils, mostly casts:—*Protocardium truncatum*, *Aviculæ*, *Pectens*, *Modiola*, &c. .. 5 6

L.—A mottled, yellow and green, shelly limestone, sometimes very hard, containing many well preserved fossils; large specimens of *Pecten liasinus* rather characteristic 2 0

Springs commonly met with.

"CAPRICORNUS" ZONE.

Dark blue clay.

I have found this typical section a very useful aid in the study of the Middle Lias of Northamptonshire, and although constructed three or four years ago with considerable diffidence, I have seen no reason for altering it materially since. It must be borne in mind, however, that the Middle Lias of Northamptonshire, like that of most districts, is a very variable formation, and so the section may be approximate only in any particular place, but certainly all the beds described do exist, as the numerous sections I shall give will show, and I think there are no others that it does not include. The variations that may be expected are these:—(1) An absence of some of the beds altogether, and this, perhaps, more often at the junction of the "spinatus" and "margaritatus" zones than elsewhere. (2) A coalescence of two or

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more of the hard beds cutting out the usual intervening clay. (3) A layer of fossiliferous nodules in place of the continuous bed.

The portion of the Middle Lias I am describing is often called the Marlstone, a term first used by Mr. William Smith to indicate that it contained hard stone bands. To this term there is some objection, for although it was applied to the whole of the formation between the Upper Lias and the zone of *A. capricornus*, the only part usually to be seen in the Midland district was the upper hard bed, here called the Rock bed, and so the term Marlstone got to be applied to this bed only. In Yorkshire Professor Phillips has named the equivalents of these beds the "Ironstone" and "Marlstone" series, the Rock bed itself being called the top Ironstone bed, and the lower beds the Marlstone.

Description of Beds in the "Margaritatus" Zone. Bed "L."

The only account that I can find of this, the lowest bed of the "margaritatus" zone, and of the Middle Lias as I intend to speak of it, in Northamptonshire, occurs in the "Memoirs of the Geological Survey," description of sheet 45 of the maps. It was written by Mr. A. H. Green, M.A., F.G.S., and runs as follows:—"At the base of the Marlstone hereabouts lies a bed of very hard, fine grained, dark blue limestone, giving out a bituminous smell when struck. It makes good road metal, and has been largely worked about Overthorpe. It may also be seen in a brick pit north-west of King's Sutton, where Twyford Lane crosses the canal."

There are not many sections in Northamptonshire where the lower beds of the Middle Lias can be seen, and for a considerable time I only knew of one where the lowest bed of the "margaritatus" zone was exposed; that was at Chalcomb, near to Banbury. Recently, however, we have been able to trace this bed over an area large enough to include Daventry to the north and Northampton to the north-east, the latter place being about twenty miles from Chalcomb. The bed has some decided characteristics, by which it can be usually identified; fossils are rather abundant, the matrix is peculiar, and it is a water-bearing bed. The particular condition of the bed at any place is better maintained along the line of strike than at right angles to it. Under *Northampton* it consists of a rather hard rock, yielding a fair amount of water; the matrix is green, but there are numerous patches (inclusions) of an ochreous colour, quite different to the rock itself, and so giving to it a peculiar mottled appearance. The green part

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is concretionary, and quite oolitic in places, the grains being flattish and elliptical in shape; a few grey micaceous patches, also many small pebbles, and some larger concretions are present. This description is quite sufficient for the same bed as it exists at *Gayton*, some five miles south-west of Northampton, almost exactly on the line of strike.

At *Milton*, to the east of this line, and *Bugbrook* to the west, the bed is a little different in character. At the former place the oolitic character is not noticeable, whereas at the latter it is very pronounced; also fossils seem more abundant as we go westward, because there is less matrix.

At *Daventry*, where the bed is superficial, and *Staverton*, where it has been long exposed, the green colour is not to be observed, partly owing to oxidation and partly because at these places it is almost entirely composed of fossils. The situation of these two sections is almost exactly on the line of strike, and near the westerly limits of the Middle Lias outcrop. If the lines connecting Northampton and Gayton and Daventry and Staverton respectively be produced, it will be seen that Chalcomb lies nearly midway between them, and the bed there possesses intermediate characters.

At *Chalcomb* the bed has the same mottled appearance that it has at Northampton, though the colour is much less decided; also it is more fossiliferous, though less so than the same bed at Staverton. Some portions of the bed at Chalcomb are exceedingly pretty; they are highly vesicular, the cavities being filled in partially or entirely with calcspar, which shows up well against the other portion of the stone—red in these cases. Several good springs issue from the base of this bed hereabouts, and no doubt running water has effected the change above referred to. An experiment in the laboratory with some of the stone from Northampton showed that the green portion was mostly soluble in hydrochloric acid, with effervescence, the ochreous portions being much less soluble.

The bed near Northampton seems to be characterised by very large specimens of *Pecten liasinus*, and everywhere by small pebbles. A little iron pyrites was found in one or two specimens, which accounted for the sulphurous odour emitted when they were struck by the hammer. The thickness seems to decrease in a northerly direction but to increase eastwards. At Chalcomb it is probably 2ft., Staverton 1ft. 4in., Daventry 1ft. 8in., Northampton between 3ft. and 4ft.

Fossils.

Ichthyosaurus tooth (?) ... Staverton.

Fish remains, vertebræ and teeth of small fish, &c. Staverton and Northampton.

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Ammonites capricornus (?) Chalcomb.
Belemnites apicurvatus ... Staverton. Some Belemnites from other places not identified.
Dentalium (?)..... Staverton.
Turbo cyclostoma ..... Milton.
Eucyclus (sp. ?)..... Staverton.
Ostrea cymbium (?)..... Northampton. Other Ostrea not identified.
Pecten æquivalvis, some very large. Northampton, Milton, Daventry, Staverton.
Pecten liasinus, mostly large specimens. Northampton, Milton, Gayton, Daventry, Staverton.
Lima .... Staverton.
Limea acuticosta..... Chalcomb, Staverton, Milton.
Plicatula (sp. ?)..... Milton.
Plicatula spinosa ..... Northampton, Milton.
Avicula cygnipes..... Northampton, Daventry.
Avicula inæquivalvis ..... Northampton, Milton, Daventry, Staverton.
Inoceramus (?) ..... Staverton.
Modiola (sp. ?) ..... Northampton.
Modiola (sp ?), *very small*. Staverton.
Macrodon (sp. ?) ..... Northampton.
Macrodon (sp. ?) ..... Staverton.
Protocardium truncatum .. Northampton, Milton, Staverton.
Cardita multicostata ..... Byfield.
Cardinia antiqua ..... Bugbrook, Staverton, Daventry, Milton.
Cardinia lævis.. ..... Northampton, Milton, Bugbrook, Staverton.
Astarte striato-sulcata..... Bugbrook, Staverton.
Gresslya intermedia ..... Northampton.
Pleuromya costata ..... Daventry.
Pentacrinite .. .. Staverton.
Serpulæ .... Daventry, Staverton (very abundant).

(To be continued.)

THE LIAS MARLSTONE OF LEICESTERSHIRE AS A SOURCE OF IRON.

BY E. WILSON, F.G.S., CURATOR OF BRISTOL MUSEUM.

(Continued from page 127.)

Finally, let us very briefly consider what was the probable origin of the Leicestershire Ironstone. At the outset we may affirm that it is impossible to suppose that the carbonate of iron

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contained in the Marlstone could have been deposited in the open sea in the state in which we now find it in that rock, because the carbonate, if introduced into such an area, would, on account of its strong affinity for oxygen, inevitably become converted into the peroxide. The presence, in abundance too, of mollusca in the Marlstone Rock precludes the idea of its contemporaneous deposition, for these animals could never have lived in such a concentrated solution of this iron compound as a percentage of thirty parts of the metal implies. The iron must, therefore, have been introduced subsequently to the formation of the rock. Speaking of the Cleveland ironstone, which, for all practical purposes, may be considered as identical with the Leicestershire stone, Dr. Sorby says, the calcic carbonate of many of the fossil shells it contains is often found to be partially or wholly replaced by the carbonate of iron, and the exteriors of the oolitic grains are also similarly replaced, indicating that they, too, have been altered after deposition. He concludes that the Cleveland ironstone was once an oolitic limestone interstratified with clays containing a large amount of oxide of iron and organic matter, which, by their mutual reaction, gave rise to a solution of bicarbonate of iron—that this solution percolated through the limestone, and, removing a large part of the carbonate of lime by solution, left in its place carbonate of iron (see Report Geol. and Polytech. Soc. of Yorkshire, Vol. II., 1856). With slight modification we may, I think, accept this theory as the most feasible one to account for the origin of the Leicestershire ironstone. For the *source* of the iron, however, we shall, I think, have to look beyond the beds themselves. If carbonate of iron were by any process developed in the impervious clays enclosing the Marlstone Rock, as suggested by Dr. Sorby, it would, in all probability, be deposited within those clays in the same way, for example, that it was in the clay-ironstone nodules of the coal measure shales, and, as a matter of fact, such nodules occur in the underlying Middle Lias shales. We have yet a great deal to learn as to the origin and distribution of metallic compounds in the sedimentary rocks. What the precise source of the carbonate of iron contained in the Marlstone of Leicestershire was, and when and how introduced, it is at the present time, and perhaps always will be, impossible to say.

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APPENDIX, No. I.

Analysis of Middle Lias Iron Ores of Leicestershire, Oxon, and Cleveland.

	Holwell.	Eastwell Ore dried at 212°.*	Adderbury (Oxon).	Fawler (Oxon).	Tilton (h.)	Tilton (d).	Upleatham (Cleveland).	Normanby (Cleveland)
Ferric oxide	46·96	55·00	30·20	44·67	3·36	5·57	3·50	2·60
Protoxide of iron			3·40	·86	36·32	26·87	33·37	38·06
Protoxide of manganese	·45	·16		·44				
Alumina	8·37	14·98	9·10	7·85	9·60	9·00	8·10	5·92
Lime	1.17	1·20	14·8	9·29	9·70	13·00	7·55	7·77
Magnesia	1·08	·88	·7	·66	2·20	1·63	3·45	4·16
Silica	10·04	13·32	12·2	·48	10·20	13·80	14·35	10·30
Sulphur	·03	·09		tr.	·08	·07	tr.	·14
Phosphoric acid	·57	·91	·7	·55	·99	·54	1·50	1·07
Combined water and organic matter	11·49	11·55					2·80	4·45
Carbonic acid	·69	1·90	13·3	6·11	27·55	29·52	25·38	22·00
Moisture	19·02		15·6	10·31 †13·10				
	99·87	99·99	100·00	100·32	100·00	100·00	100·00	96·47
Metallic iron per centage	av. 30	38·50 av. 30	23·7	30·0	30·60	24·80	28·42	31·40

* When first got this ore contains about 25 per cent. of moisture. † Insoluble residue.

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APPENDIX II.

Notes on the Palæontology of the Marlstone of Leicestershire.

With the exception of *Rhynchonella tetraedra* and *Terebratula punctata*, which are found everywhere, and in enormous numbers in the "jacks," the fossils of the Leicestershire Marlstone are neither very numerous nor greatly varied. In comparison with the Marlstone of Oxfordshire the fauna is extremely limited. Mr. Beesley, of Banbury, gives a list of upwards of 250 species from the zone of *A. spinatus* in that county; whereas for Leicestershire I am not able to mention more than a quarter of that number. Of these *A. spinatus* is rare, and except at Tilton, where we also get *A. communis*, *A. annulatus*, *A. Holandrei*, *A. Coecilia* (?), *A. acutus*, and *A. serpentinus*, no other ammonite is to be found. The remarkable abundance of *A. acutus* in the top bed at Tilton has already been mentioned. Belemnites occur everywhere in the Rock-bed, the prevailing forms being *B. elongatus* and *B. paxillosus*. The only other *common* fossils are *Pecten æquivalvis*, *P. lunularis*, and *Lima pectinoides*. Some very interesting little Gasteropoda are to be found in the railway cutting south of Tilton Station, and also in a quarry on the east side of Pickwell, a village about three miles to the north-east. Both *Rhynchonella tetraedra* and *Terebratula punctata* show varietal forms: they also show great variations in the stage of growth of the shells, and the latter occasional monstrosities.

The general character of the Marlstone Rock, its coarse arenaceous nature and oolitic texture, the occurrence of beds largely composed of shell fragments, the presence of current-bedding, and the occurrence of drift wood indicate that it was originally a shallow water, and probably a shore (if not an estuarine) deposit. The local development of this rock is, I believe, to be explained by original limitation of deposition and not by subsequent denudation. I have already mentioned that, on lithological grounds, the Marlstone Rock can be divided into two very distinct portions—an upper calcareo-ferruginous and fossiliferous division and a lower arenaceous and much less fossiliferous division. The Rock-bed cannot be further sub-divided into zones either on palæontological grounds or by lithological characters. As a rule the "jacks," of which there may be one, two, or more, occur in the lower half of the upper or ferruginous series, but they are sometimes met with in the lower series. The "jacks" rapidly pass into ordinary compact marlstone, and cannot be identified in the different exposures.

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The encrinital bands are generally found above the "jacks," but at Holwell and also at Knipton and Branston near Belvoir they occur at the base of the ferruginous series. The base of the Marlstone can always be fixed by the band of phosphatic concretions above referred to. *Ammonites acutus* and the other ammonites, *A. spinatus* only excepted, are never found except at the top, but so far these ammonites have only been found at one place, viz., Tilton. I append a list of the organic remains already known to occur in the Marlstone Rock of the Leicestershire district. The species from Tilton are placed in a separate column, from which it appears that a greater number of fossil forms have been found at that place than at all the other localities put together. Further search, especially in fresh exposures, will no doubt appreciably extend the list here given.

In drawing up this list I have received very material assistance from Mr. T. Beesley, F.C.S., of Banbury, and also from Mr. H. E. Quilter, of Leicester, who has very kindly placed a number of his fossils at my disposal. I wish also to acknowledge the valuable information that has been at different times given me by Mr. H. W. Sadler, resident engineer for the new Eaton and Eastwell branches of the Great Northern Railway, as to the character of the rocks met with on those lines; and also by Mr. W. Ingram, of Belvoir; Mr. H. A. Allport, of Barnsley; Mr. R. Dalgliesh, of Holwell; and Mr. E. E. Coke, of Nottingham, as to the history of the Leicestershire ironstone industry.

LIST OF FOSSILS FROM THE MARLSTONE ROCK OF THE LEICESTERSHIRE DISTRICT.

	Tilton.	Other localities.
Plantæ.		
Fossil wood	×	×
Echinodermata.		
Pentacrinus lævis, Mill.	×	
,, sp.	×	×
Annelida.		
Serpula quinquesulcata, Goldf.	×	
Brachiopoda.		
Rhynchonella tetraedra, Sow.	×	×
,, ,, var. Northamptonensis	× top	
,, acuta, var. bidens, Phil. ...	×	

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	Tilton.	Other localities.
Terebratula punctata, Sow.	×	×
,, ,, var. sub-punctata, Dav.	×	×
,, ,, ,, Radstockensis, Dav.	×	
,, ,, ,, Edwardsii, Dav. ...	×	×
,, ,, ,, Haversfieldensis, Dav.	?	
Lamellibranchiata.		
Cardinia concinna, Sow.	×	
Monotis inæquivalvis, Sow.	×	×
Gresslya lunulata, Tate	× base	
,, intermedia, Simpson	× base	
Cardium truncatum, Sow.		×
,, substriatulum d'Orb.		×
Leda complanata, Phil.		×
Ostrea, sp.	×	×
Plicatula spinosa, Sow.	× top	×
Placunopsis, sp.	×	
Pleuromya, sp.	× base	
Pecten dentatus, Sow.	×	
,, æquivalvis, Sow.	×	×
,, priscus, Schloth.	×	
,, sublævis, Phill.		×
,, cingulatus, Goldf.		×
,, lunularis, Rom. (P. Liasinus Nyst.)...	×	×
,, textorius, Schloth.		×
Hinnites abjectus, Phil.	×	
,, tumidus, Zieten		×
Lima pectinoides, Sow.	×	×
Macrodon Buckmanni, Buck. (=Arca elongata, Quenstdt.)	×	×
Modiola scalprum, Sow.	×	×
Mytilus, sp.		×
Inoceramus substriatus, Goldf.		×
Unicardium subglobosum, Tate	×	
Gasteropoda.		
Cerithium ferreum, Tate	× top	
,, confusum, Tate	× top	×
,, reticulatum		×
Actæonina Ilminsterensis, Moore		×
Eucyclus Gaudryanus, d'Orb.	× top	
Phasianella turbinata, Stoliczka	× top	×
Cryptænia expansa, Sow.	× top	×

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	Tilton.	Other localities.
Trochus ariel	× top	×
,, Æolus, d'Orb.		×
Turbo Brannoviensis, Dumort.		×
,, latilabrus, Stoliczka		×
Cephalopoda.		
Nautilus truncatus, Sow.	× top	
Ammonites spinatus, Brug.	× top	×
,, communis, Sow.	× top	×
,, annulatus, Sow.	× top	
,, margaritatus, De Montf. ...	× base	
,, Holandrei, D'Orb.	× top	
,, serpentinus, Rein.	× top	
,, Cæcilia, Rein.	× top	
,, acutus, Tate	× top	
Belemnites paxillosus, Schloth.	×	×
,, elongatus, Mill.	×	×
,, clavatus, Schloth.		×
,, apicicurvatus, Blainville ...	×	
Pisces.		
Sp. (?)—tooth		×
Reptilia.		
Ichthyosaurus, sp.—vertebra	×	×

NOTES ON THE MYMARIDÆ.

BY F. ENOCK.

In the sixth volume of "The Entomologist," 1873, p. 498, under the above heading, is the following remark by the late Francis Walker:—"The Mymaridæ are more atom-like than all the other Hymenoptera, and thus; in comparison with them, are nearest on the surface of creation to spaceless infinity."

Many of these exquisitely beautiful "Fairy Flies" are very common, and only want to be carefully looked for to bring to light many new species, but unfortunately our knowledge of the Mymaridæ is far too small; therefore the difficulty of identifying our captures is very great. I should not have been able to give these few notes had it not been for

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the kindness of Mr. Ed. Fitch, Hon. Secretary of the Entomological Society, London, who named over a hundred and fifty specimens of Mymaridæ and other minute Hymenoptera for me from the various German authors. I trust that ere long some "native" will endeavour to give some account with figures of the British Mymaridæ, as no doubt there are plenty of materials in our own country to form a very good monograph.

The following is a copy of "Foerster's Synopsis," which has been very much simplified by an old friend, so that anyone can easily ascertain to which genus any specimen belongs. The numbers on the right refer to those on the left.

MYMARIDÆ.

1. Tarsi 5-jointed 2
   „ 4 „ 8

2. Abdomen distinctly petiolated 3
   „ sessile or nearly sessile (male) 4
   „ „ „ „ (female) 6

3. Antennæ of the male 10-jointed; female, 9-jointed— CAMPTOPTERA
   Antennæ of the male 13-jointed; female, 11-jointed— OOCTONUS

MALE.

4. Marginal branch extending to the middle of the costa— LIMACIS
   Marginal branch not extending to the middle of the costa.. 5

5. Antennæ 13-jointed .. .. GONATOCERUS
   „ 10 „ .. .. ALAPTUS

FEMALE.

6. Antennæ 11-jointed .. .. GONATOCERUS
   „ 9 „ .. .. LITUS
   „ 8 „ 7

7. Marginal branch extending to the middle of the costa— LIMACIS
   Marginal branch not extending to the middle of the costa— ALAPTUS

8. Club of the antennæ with two joints 9
   „ „ not jointed 10

9. Marginal branch very long—Tarsi of the four hinder legs shorter than the tibiæ .. .. EUSTOCHUS
   Marginal branch very short—Tarsi of the four hinder legs longer than the tibiæ .. .. DORICLYTUS

10. Abdomen distinctly petiolated 11
    „ sessile or nearly sessile 14

11. Fore wings only widened at the tip .. .. MYMAR
    „ „ „ throughout 12

12. Marginal branch punctiform .. .. .. COSMOCOMA
    „ „ elongated 13

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13. { Metathorax with two keels, antennæ of female 9-jointed— CARAPHRACTUS
Metathorax not keeled, antennæ of male 10-jointed; female, 9-jointed .. .. STICHOTHRIX

14. { Antennæ of the male 12-jointed; female, 9-jointed, marginal branch elongated, somewhat thickened near the tip — ANAPHES
Antennæ of the male 13-jointed; female, 9-jointed, marginal branch linear, *not* thickened near the tip ... ANAGRUS

My first acquaintance with the Mymaridæ was made at Holloway, London, where, in the garden, surrounded by the usual "cats' highway" (a four foot wall) I used to find Anaphes and Anagrus tolerably plentiful on hot sunny days. I have seen them flying, and have caught them in my hand; though more frequently they were entangled in the webs of the Garden Spider, *Epeira diadema*, but far too small for that individual to notice. It was in a very dirty web that I first found the long-sought-for gem *Mymar pulchellus*, so no one living in town need despair of being able to find some of the Mymaridæ.

During the latter end of the summer of 1884 I obtained a large number of various species, representing the following genera, viz.:—Anaphes, Anagrus, Alaptus, Camptoptera, Cosmocoma, Gonatocerus, Litus, Mymar, and Ooctonus. The first to appear was *Anaphes punctum*, which I found in June—flying, on various shrubs, walking about window panes, besides sweeping them from low herbage in fields and on banks. This is one of the strongest built, its black colour enabling it to be easily seen on windows, as it runs steadily up and across until it meets with some obstacle, when it immediatly hops off (I can scarcely call it flying) a short distance. The delicate yellow *Anagrus* moves along in the most graceful manner, its long fringed wings just sweeping the glass, and when needful altering its direction by a most fairy-like turn of its train; when disturbed it quietly, and apparently with some difficulty, disengages its wings one from the other, then it takes a short flight, settling upon the glass again like a tiny speck of dust.

Alaptus is the smallest, therefore the most difficult to see, rendered still more so by its habit of not putting in an appearance until September, and seldom before half-past four or five o'clock; it has a most peculiar jerky gait, walking for about an inch-and-a-half; then off at an angle or back again for the same distance.

Camptoptera too appears in September, and, like Alaptus, seems to prefer the waning light of day before taking its

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walks abroad on the panes of a greenhouse, which is one of the best places to look for these "Fairy Flies," and I would recommend some of those "arm-chair collectors," who cannot possibly take so much exertion as is necessary to bend their back or legs to run after an insect, to take their seat at the end of the greenhouse, and if not too lazy to raise their eyes they will, in the course of an hour or two, see enough insect life on the glass to occupy their thoughts for a long time. But I am wandering away from *Camptoptera*, which is one of the most gracefully built of all the Mymaridæ, the head, thorax, and abdomen being beautifully shaped, the wings too are arched in a line of beauty and grace with long fringes of hair or setæ on the margins, and its step is indeed light as a fairy.

Cosmocoma contains some of the largest species of the family, the wings paddle shaped with long setæ especially along the outer margin, and one, the name of which I am unable to certify, has these long setæ on both sides of the upper wings as well as along the margins, thus resembling a bottle brush. *Gonatocerus* and *Ooctonus* are about the plainest fairies, but nevertheless beautiful.

Litus, when seen crawling up the glass, looks much like a very minute flea; it has a decidedly heavy body, but the wings are very narrow and delicately fringed. I have left *Mymar pulchellus* until last, as it is one of the most extraordinary insects I have ever met with, the anterior wings are almost the exact shape of a battledore or lawn tennis bat, the posterior being but short bristles, with a few hooklets which hook into the groove in the anterior wings, and when this insect is examined under the microscope we cannot help being struck with the marvellous arrangement of this under wing which so supports and "ties in" the long rib of the anterior one, thus preventing it from unduly bending.

I have often been asked "Where do you get these things from," and I can only add that they are to be found almost everywhere if looked for; since I have devoted some little time to the study of them, I am almost afraid to tread upon a lawn, knowing that each step taken crushes the life out of many of these most marvellous atoms, for no doubt a great many are parasitic upon the various dipterous and other larvæ feeding in the stems and upon grasses and other low herbage, whilst others keep down the swarms of Aphides. Still more wonderful, some of them search for the eggs of Lepidoptera, which they pierce with their minute ovipositor, then transmit one egg or more of their own, the young larvæ feeding upon the fluids contained in the butterfly's egg until

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they are full fed, when they assume the pupa state, and when fully matured the perfect fly eats its way through the shell of the butterfly's egg, emerging into light and freedom.

Sir John Lubbock mentions in the "Linnæan Transactions," Vol. 24, p. 142, having found one species, which he named *Prestwichia aquatica*, as using its wings to enable it to swim under water. This one lays its eggs within those of a dragon fly.

It is a curious fact that in most cases the females are far more plentiful than the males, as the following list will prove, taken from my journal for the past three years :—

	Males.	Females.
Anagrus	6	41
Anaphes	55	40
Mymar	1	4
Litus	0	12
Cosmocoma	2	5
Alaptus	3	24
Camptoptera	0	110
Gonatocerus	5	10
Ooctonus	1	5

I cannot in any way account for the extraordinary difference in Camptoptera ; in fact, I could not believe all were females until I had most carefully counted the joints of the antennæ, and even the setæ around the wings ; but I was obliged to own I had never captured a male, though I searched for them at all hours, in all sorts of places, and in all sorts of weather. I never saw the ghost of one until Mr. Gooch, of Eton, very kindly sent some specimens of Mymaridæ for my examination, amongst them two Camptoptera, one of which was a male.

Beside the above representatives, I have two species which I have utterly failed to identify as belonging to any of the genera mentioned in "Foerster's Synopsis ;" no doubt they will prove additions to this most interesting family, many of which do not measure more than one-fiftieth of an inch from head to tail, and yet within this compass is contained the complete organism of a perfect insect, almost too wonderful for our minds to grasp.

"Then sweet to muse upon his skill displayed,
(Infinite skill) in all that he has made !
To trace in Nature's most minute design
The signature and stamp of pow'r divine,
Contrivance intricate, express'd with ease ;
Where unassisted sight no beauty sees,
The shapely limb and lubricated joint,
Within the small dimensions of a point.
Muscle and nerve miraculously spun,
His mighty work who speaks and it is done.
Th' invisible in things scarce seen reveal'd,
To whom an atom is an ample field."—*Cowper.*

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THE PRE-CARBONIFEROUS FLOOR OF THE MIDLANDS.

BY W. JEROME HARRISON, F.G.S.

(Continued from page 135.)

In the Orton boring even the Trias was absent, and the Lower Lias reposed on a quartz-felsite which was penetrated to a depth of seventy-four feet. This rock appears to me* identical with the quartz-felsite of the Caldicote pit (Nuneaton). Its position—twenty-five miles south-east of Charnwood—shows a much greater extension of the line of upheaval marked by the anticlinals of Charnwood and Hartshill than was previously known. At Rugby the boring was clearly in a filled-up valley, for although several hundred feet of red marls and sandstones were passed through (underlying an equal thickness of Lias), yet the boring terminated in the Upper Trias. A good supply of water was obtained, but it was so salt as to be unfit for domestic use.

The Sapcote boring in South Leicestershire was commenced in 1863. After passing through 540 feet of Triassic marls and sandstones the boring tool reached indurated shaly and slaty beds of a dark colour, much jointed, and dipping at a very high angle; a total depth of 1,655 feet was obtained. I believe these beds to represent part of the Stockingford Shales, and therefore to be of Cambrian age. Mr. Bosworth, by whom the Sapcote boring was executed, speaks of the shales of the Stockingford cutting (at a time when the latter were thought to be Coal-Measures), as "similar to those at Sapcote." He also refers to the Sapcote cores as "precisely similar to those found at Evington."

The three borings next in order—those commencing in the Rhætics and Lower Lias on the east side of the town of Leicester—were executed between 1876 and 1880. At the first boring, on the eastern foot of the Spinney Hills, a bed of running sand was met with in the Trias at a depth of 750 feet, and the difficulties were so great that the boring was abandoned at this point. At the next attempt old rocks were reached at a depth of 728 feet, and the boring was discontinued at 819 feet. The third boring, a mile further east, reached similar strata at 836 feet, and ended at 1,002 feet. The bottom rocks in these two bore-holes were dark-blue, much jointed, coarse, indurated shales or slates, just like what the Stockingford shales would be when unweathered. No fossils were

* I have examined the cores from most of the borings given in the table.

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detected in them, but they may be assigned with much probability to the Cambrian period. The Owthorpe boring, six or seven miles south of Nottingham, passed through sixty-six feet of Lower Lias and Rhætic beds, and 1,000 feet of the Trias, below which the coal-measures were found.

At South Scarle, between Newark and Lincoln, the Trias occurred in full force. The section here gives

	Feet.		Feet.
Drift	10	Keuper Waterstones	244
Lower Lias	65	Bunter Sandstone	542
Rhætic Beds	66	Permian Beds	519
Keuper Marls	573	Coal-Measures?	10

The pebble-beds of the Bunter were here entirely wanting. At a depth of 2,019 feet deep red indurated marls with nodules of hæmatite were found, which are believed to be upper coal-measures.

Of borings east or west of the line which we have now described, only two or three need be mentioned. On the east, at Harwich, the Gault was found to rest—at a depth of 1,030 feet—upon dark slaty rocks, which the presence of a *Posidonia* proved to be of Lower Carboniferous age.

On the west, two or three borings were put down in the neighbourhood of Market Bosworth, in West Leicestershire, between 1878 and 1880. These proved that the coal-measures do not extend uninterruptedly beneath the new red marls as was originally supposed. Indurated and jointed shales varying in colour from red or purple to blue or grey (probably the Stockingford Shales) were found and pierced to a considerable depth without being bottomed. At Burford, near Oxford, a considerable thickness of the Trias was found to rest upon coal-measures, which were reached at a depth of 1,184 feet.

The cores brought up from these borings in many cases show clearly the dip of the old rocks—usually at a considerable angle, 30 degrees or more—but unfortunately we are unable to determine from them the direction of the dip, for the cores are of necessity moved and, perhaps, rotated many times before they can be brought to the surface. By letting down a compass which could be fixed to the top of the core, and then fixing the direction of the needle by means of a stop, actuated by an electric current, it would seem to be possible to find out this important point.

It is most desirable that the borings which have been made should be supplemented by others, put down at points selected by a committee of those geologists who have specially studied the subject. The expenses might be defrayed partly by Government, partly by a rate (voluntary or otherwise) levied upon the landowners of the district.

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As the coal supply diminishes from the exhaustion of the present proved areas, such experimental borings will doubtless be undertaken.

Relations of the Post-Silurian strata to the Midland Axis.—There is no evidence of the extension of the Old Red Sandstone to the east of the Severn. Whether it was formed in a lake, or in a delta, it is probable that it was pretty well confined to the region where it is now exposed. The Carboniferous rocks thin from north to south in the most marked manner as they approach the Charnwood-Longmynd line. There is a thin impure representative of the mountain limestone on the north-west flank of Charnwood, but even this is absent (together with the millstone grit) in Warwickshire and Staffordshire. It is true that the Northampton borings yielded fossils of this age, but they were from sandstones and marls, the shallow water representatives of the grand 3,000 feet thick deep-sea limestone of Derbyshire.

The manner in which the South Staffordshire coal-measures rise up and terminate against a sub-terrestrial ridge of Silurian rocks on the south of Halesowen has already been described.

Of the succeeding Permian strata, we find that in Notts. the Magnesian Limestone (Lower Permian) decreases from above 100 feet at Shireoaks to 30 feet at Bulwell; showing that as we pass southwards we are approaching its ancient limit or shore-line, the region round Charnwood Forest. Westward, in South Staffordshire and Shropshire, the Permians are thicker, but they show every sign of the presence of land immediately to the south during the time of their formation. South of the line of the ancient axis we get no indications of Permian strata; they are wanting in all the borings made in this direction, and they nowhere occur at the surface.

The Triassic Formation, above 3,000 feet thick in Cheshire, and possibly of equal thickness in Yorkshire and Durham, thins away steadily (the lower beds disappearing first) to the south. The Bunter Pebble Beds barely reach to Leicestershire; their thickness decreasing from above 300 feet in Cannock Chase to a mere band of 10 feet in the railway-cutting at Gresley in north-west Leicestershire, and the borings further south show only a small thickness of the "red rocks," and that of a littoral nature, between Northampton and London. Between the Malvern and the Mendip Hills the Bunter Beds (Lower Trias) are absent, and a thin layer of the Keuper, evidently a shore deposit, rests on Devonian and Carboniferous rocks.

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The Jurassic System has an uninterrupted outcrop from Dorset to Yorkshire, crossing the old land, and probably filling up one of its valleys, near Northampton. But neither Liassic nor Oolitic strata have any eastward extension, for the borings prove their absence, except in the most fragmentary form, between Ware and Richmond.

Fragments of the Pre-Carboniferous Floor contained in newer rocks.—The Carboniferous strata of the Midlands contain but few rock-fragments or pebbles of the formations upon which they rest. This is not a matter of surprise when we remember that the mountain limestone is a deep-water formation, whose actual junction with its southern shore-line is nowhere exposed, although we approach within a hundred yards or so of it at Gracedieu, on Charnwood Forest.*

The Millstone Grit of Stanton Harold and Ticknall (N.W. Leicestershire) is only 200 feet thick, and contains a quartzitic conglomerate. Much of the rock may be termed "arkose," the cemented felspar and quartz crystals of which it is composed having suffered very little wear.

The coal-measure shales must have been deposited in very quiet waters—perhaps in the swamps and deltas of the many mouths of a mighty river like the Amazon or the Mississippi. No bare rocky ledges or abrupt sea-cliffs existed along the shore-line to furnish shingle beaches, but monotonous flats, formed perchance by the Silurian shales.

In Leicestershire the Permians exist only as thin patches of breccia, consisting of green slates, grits, quartzites, and greenstones, some of which are polished and striated. The so-called Permians of the Warwickshire coal-field I believe to be largely upper coal-measures.

In Staffordshire the Permians of the Clent Hills are so charged with rock-fragments that these heights were formerly thought to consist of solid trappean rock. Near Northfield the same strata are crowded with angular blocks of Silurian limestone and sandstone, quartzite, &c., so that Prof. Jukes (who surveyed the district) was compelled to the belief that "a boss, or peak, or ridge of the Silurian sandstone lies concealed under the Permian rocks somewhere close by."†

In Shropshire the Permian breccias of Alberbury west of Shrewsbury, consisting of angular fragments of Silurian and Lower Carboniferous rocks, are no less than 400 feet thick.

* The actual junction is here hidden by a patch of Triassic sandstone, which rests unconformably on the edges of the Forest rocks and the limestone.

† Geol. S. Staff. Coal-field, p. 9.

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But it is in the Trias that evidences of the proximity of land become most numerous and most striking. Breccias and pebble beds occur on two distinct horizons in the Triassic series—(*a*) in the Bunter Conglomerate, and (*b*) in the Keuper Basement Breccia.

(To be continued.)

THE EAR AND HEARING.

BY W. J. ABEL, B.A., F.R.M.S.

(Continued from page 123.)

In Animals partaking of the nature of two classes, the ear is still a constant mark of difference. The Ornithorhynchus and other Monotremata, for example, possess the columella of a bird; whilst the whale and other Cetacea have a peculiar ichthyic-mammalian ear. The whale, for example, would seem to hear, as it were, backwards, for the eustachian tube opens into the blow-hole, and the external orifice is nearly closed. The petrotympanic bone acts as a true otolith, whilst the mammalian ossicula (small ear bones) and tympanic membrane are also present. When, therefore, the cetacean comes to the surface for air, it is able to hear aërial vibrations through the medium of the eustachian tube, the while the otolithic ear is immersed, and cognisant of aquatic sounds.

It is in the mammalian ear that we reach the highest perfection. The external ear is now added (very motile in the lower animals, and to some extent also in certain men, especially savages), possessing a suite of muscles, and every appliance for the discrimination of the faintest sounds.

The cochlea, which we found commencing in reptiles, is here very complex, enabling the mammal to distinguish delicate shades of tone. The tympanic membrane is also fully exposed to aërial vibrations, whilst the columella is replaced by a chain of exquisite ossicles, connecting, as the columella does in birds and reptiles, the tympanic membrane with the covering of the fenestra ovalis, which communicates with the internal ear.

Taking the human as our type of the mammalian ear, we may describe it as consisting of three parts—the external, middle, and internal ear (or labyrinth).

The *External Ear* includes the visible part called the Auricle or Pinna and the passage leading to the membrane of the drum. The auricle consists of one piece of cartilage having divisions scattered throughout it, and penetrating

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nearly through its thickness, thus giving to it great flexibility. It is attached to and moved upon the head by three sets of muscles—anterior (*attrahens*), superior (*attollens*), and posterior (*retrahens*). It possesses also several intrinsic muscles, which in man are feeble and scarcely distinguishable, seeming to be merely rudimental of those more highly developed muscles found in the large ears of most quadrupeds, enabling them to alter the form and direction of the auricle. The divisions of the Pinna are (1) the Helix, or outer rim; (2) the Anti-helix, parallel with it; (3) the Concha, or deep depression which focusses and reflects sound vibrations; (4) the Notch, or lowest part of the concha; (5) the Tragus, on the cheek side of the notch; (6) the Anti Tragus; and (7) the Lobe, or soft pendulous part below the notch. The canal (*Meatus Externus*) opening to the Drum is about an inch to an inch and a-half long—shortest in childhood, when the inner or *bony portion* of the meatus is wanting, being represented by a mere tympanic ring. Its direction is curved, and slightly tortuous, convex above, and oval in section. It is closed internally by the nearly circular membrane of the drum, which is inclined outwardly at an angle of about 45deg. with the floor of the canal. The canal is lined in its external part with fine hairs, and studded with ceruminous glands, most numerous about the centre. These glands secrete the Cerumen or ear wax, which serves partly for cleansing the passage, and partly perhaps, by its intensely bitter taste, to keep out insects.

The *Middle Ear* or Tympanum is the irregular space between the tympanic membrane and the internal ear. It measures about $\frac{1}{4}$in. from the membrana tympani to the vestibule, and about $\frac{1}{2}$in. in its other two diameters. The tympanic membrane is fitted into a groove in a ring of bone, which is said to assist in conveying to the membrane sound vibrations communicated through the cranial bones. The membrane is thin and semi-transparent, but consists of three layers—an outer layer continuous with the cuticle of the external meatus—an inner layer continuous with the mucous membrane of the tympanum, and a middle layer of fibrous tissue on which its strength depends, very elastic and containing blood vessels and nerves. Its fibres are chiefly radial, but there appear to be a few circular ones near the outer edge. The roof of the tympanum communicates posteriorly with a number of air cavities (the mastoid cells in the mastoid process of the temporal bone). In the floor is the opening of the eustachian tube, a narrow canal about an inch and a half long, enlarged at both ends, especially at

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its nasal end, where it forms a trumpet-like dilatable opening on the side of the pharynx just behind and above the soft palate (*velum*) and tonsil. The use of the tube is to preserve an equilibrium between the air within and without the tympanum, and to sweep away, by means of its cilia, the mucus secreted in the cavity of the tympanum and by its own walls. The outer air is constantly varying in density, and, were the drum a closed chamber, the membrane would be liable to strain from without with each increase in density of the outer air, and from within with each decrease. The sense of pain felt in the ears when going up in a balloon or down in a diving bell, and sometimes also after vigorously blowing the nose, is relieved by repeated swallowing, which act dilates the pharyngeal end of the tube for the admission of air from the mouth and nose, thereby equalising the density of the tympanic and external air.

(To be continued.)

RORAIMA MOUNTAIN.*

BY W. P. MARSHALL.

Roraima is a remarkable mountain in South America that has just been ascended for the first time by a special traveller and botanist, who have obtained some very interesting results. The mountain is in British Guiana, near the middle of the northern coast of South America, about 200 miles distant from the coast and close to the boundaries of Brazil on the south, and Venezuela on the west. British Guiana is a state about equal in size to England, containing several ranges of mountains of moderate heights (about the height of those in Great Britain); but one mountain, Roraima, the highest of them, is 6,000 feet high, or half as high again as Ben Nevis, our highest mountain. The country is tropical, being within five degrees of the equator, and is a specially rich orchid region; the approach to the mountain is difficult, and is described as "four days' walking through a purely savannah but most glorious country, and over splendid mountain passes, leading to an inconceivably magnificent valley on the southern slope of Roraima."

* Transactions of the Birmingham Natural History and Microscopical Society.

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The mountain is of a very singular and unique form; the base rises with a gradual slope all round of about 1,500 feet height, and the mountain then suddenly shoots up with nearly vertical cliffs several hundred feet high to the full height of 6,000 feet above the sea; these vertical cliffs extending all round, and making the mountain exceptionally difficult of ascent. The ascent has now been made by Mr. Everard F. Im Thurm, who was sent out jointly by the Royal Society and the Royal Geographical Society, and was accompaied by Dr. Siedel, a German orchid collector; this ascent of Roraima has been a cherished object of botanical exploration in South America for the last quarter of a century.

The ascent, though laborious, was not dangerous, but in order to make the ascent of the latter steep portion, "the travellers were compelled to climb trees and to leap from rock to rock." The top of the slope is described as "a most beautiful spot, a very garden of orchids and most beautiful and strange plants," and "when they ultimately reached the summit they were surprised to find that it consisted of a broad plateau, twelve miles in length by four in breadth, on which they discovered some forms of vegetation previously unknown to science, and a vast number of fantastically-shaped rocks." Mr. Im Thurm states—"The vegetation on the top was most wonderful, but somewhat scanty and quite dwarf. I have, I believe, 300 to 400 species; also some living plants, including Heliamphora and three most exquisite Utricularias, two of which are I fancy new." It has hitherto been assumed that the mountain was crowned with trees, whereas they could find nothing of larger growth than shrubs about three feet high. Another delusion which has also been dissipated is that the loftier altitudes of Roraima sheltered strange animals; but these existed only in the imagination of Indians, for, with the exception of a few butterflies, the travellers saw no trace of animal life. All the explorers of British Guiana refer to the cascades that abound on the sides of the mountain; and these, it appears, are fed from numerous pools of water on the top plateau, the view from which is described as being of surpassing grandeur. Mr. Im Thurm by his achievement has added another page to the history of successful geographical research, and has fully justified the support he has received from the Royal Geographical Society. He started on his exploration on 16th October last, made the ascent of the mountain on December 3rd, and reached George Town, the port of British Guiana, on his return journey on January 31st.

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MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

The EIGHTH ANNUAL MEETING will be held at Birmingham on Tuesday and Wednesday, the 16th and 17th June instant.

PROGRAMME FOR TUESDAY.

The ANNUAL MEETING will be held in the Examination Hall, Mason College, Birmingham, on Tuesday, June 16th, at 3.15 p.m., the President of the Union (Mr. R. W. Chase) in the Chair. The business of the Meeting will be to receive the Report of the Council and the Treasurer's Accounts; to fix the place of the next Annual Meeting in 1886; to award the Darwin Medal for the year 1885; to consider any suggestions that Members may offer; to discuss the work of the Union during the coming year; and to transact all necessary business. The President will open the Meeting with an Address.

RECEPTION ROOM.—A Reception Room will be provided at the Society's Library, Mason College, for members of the Union and other visitors, and letters may be addressed there. An arrival book will lie on the table, and it is hoped that all visitors will enter their names and temporary addresses in it, for the information of friends who may desire to communicate with them. The same room will also serve as a news room, and will be supplied with newspapers.

CONVERSAZIONE.—A Conversazione will be held, by permission of the Mayor (Ald. Martineau), in the Town Hall, Birmingham, on Tuesday Evening, June 16th. There will be an Exhibition of Objects of general Scientific Interest, Microscopy, various departments of Natural History, Art, and Archæology. Members of Societies in the Union and friends willing to contribute specimens, or to exhibit or lend microscopes, will oblige by at once communicating with Mr. J. Morley, Society's Room, Mason College, Birmingham. At intervals a selection of music will be performed upon the grand organ by Mr. Stimpson. The charge for admission to the Conversazione will be 2s. 6d. Doors open at half-past seven. Morning Dress. Carriages may be ordered for half-past ten. Tickets are now ready, and can be obtained by members for themselves, and for friends not members of the Union, through any of the Secretaries of the Societies in the Union, or direct from Mr. J. Morley, Mason College, Birmingham.

PROGRAMME FOR WEDNESDAY.

EXCURSIONS.—On Wednesday, June 17th, there will be three Excursions, viz.: to Coventry and Kenilworth; to Cannock Chase; and to The Lickey.

Coventry and Kenilworth.—The train will leave Birmingham (New Street) at 9.40, arriving at Coventry at 10.11. The party will be met at the station by Mr. W. G. Fretton, F.S.A., who will conduct the members to the following places of interest in the city: Site of Cheylesmore Manor House, Grey Friars Spire, now attached to Christ Church; all that remains of the Franciscan Monastery, Ford's Hospital, a mag-

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nificent specimen of timber work; St. Michael's Church, St. Mary's Hall, Holy Trinity Church, Remains of the Benedictine Priory and Cathedral, Remains of City Walls and Gates, St. John's Hospital, now the Free Grammar School, Batlake Hospital, and St. John's Church, to Craven Arms Hotel to lunch at 12 o'clock.

Leave for Kenilworth in conveyances at 1 o'clock, viâ Stivichall, Avenues of Oak, along the Warwick Road. Turn off at Gibbet Hill for Stoneleigh, Ancient Church, Motslow Hill, the Abbey, and Thickthorne Woods, to Kenilworth Castle. Mr. Fretton will describe the ruins and conduct the party by way of the remains of the Priory and the Parish Church, to the Station.

Leave Kenilworth at 5.34; arrive in Birmingham at 6.10; Meat Tea at Grand Hotel at 6.20. Tickets 12/- each, or without Meat Tea 10/-.

Cannock Chase.—The train will leave Birmingham (New Street Station) at 9 20, arriving at Brownhills at 10 10; proceed by Cannock Chase Colliery Company's engine up their line of railway and visit their collieries; proceed to the Cannock and Rugeley Collieries, look over the surface arrangements at Cannock Wood Pits, and those persons who are so disposed can descend the various pits. Luncheon will be provided at the Anglers' Hotel, Hednesford, at 2 30. After luncheon, visit the Cannock and Rugeley Company's Pool Pits and the Hednesford Canal Wharfs. Leave Hednesford Station at 4 55, arriving in Birmingham at 6 15. Tickets, 8s. each. Meat tea at the Grand Hotel, at 6 20. Tickets, 2s. 6d. each.

The Lower Lickey Hills.—For Geologists, Photographers, Botanists, &c.—Leave Snow Hill Station (Great Western) by 10 A.M. train, arriving at Rubery 10 51. Examine coal measures and Upper Silurian rocks in the Asylum Grounds, with the basement bed—Llandovery Sandstone resting on an eroded surface of Quartzite. Study the Quartzite in the grand section at the railway station (Rubery), and in numerous fine sections between that point and Barnt Green. Walk to Kendal End, where the Wenlock Limestone and brecciated rocks are exposed, and trace the sequence down to the Quartzite (which is of either Cambrian or Pre-Cambrian age) and to the rocks which, at the southern end of the Lickey, lie beneath the Quartzite—volcanic ashes unquestionably of Pre-Cambrian age. The last-named strata are exposed in the brook-course near Kendal End. Numerous fine boulders of Welsh felstone are scattered over this region. Distance to be walked, about four or five miles. Return by 5 20 train (Midland) from Barnt Green, arriving in Birmingham (New Street Station) at 6 P.M.; Tea at the Grand Hotel at 6 20. Tickets 5s. each, or 3s. without Meat Tea. A call will be made at the "New Rose and Crown Inn," where light refreshments may be obtained.

Tickets must be applied for not later than Monday, June 15th, and may be procured from Mr. J. Morley or Mr. T. Bolton, Society's Room, Mason College, Birmingham, between twelve and three o'clock, or by post.

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METEOROLOGICAL NOTES.—April, 1885.

The barometer was rising at the commencement of the month, but fell from the 3rd to the 6th, and thence rose gradually to the 19th, when it reached its highest point, 30·328 inches; it again fell rather rapidly to the 26th, and continued unsteady. Temperature was low until the 17th, when the maximum was 64·7°, as against 43·9° the previous day. The mean was about one degree below the average. The highest readings were 71·5° on the 19th and 71·4° on the 21st at Loughborough; 71·1° at Hodsock, on the 21st; 70·0° at Henley-in-Arden, on the 19th; 69·9° at Coston Rectory, and 69·8° at Strelley, on the 21st. These maxima are unusually high for the month of April. In the rays of the sun, 126·7° was recorded at Hodsock and 123·9° at Loughborough, on the 21st; 123·6° at Strelley, on the 20th. The minimum readings were lower than usual: 20·7° at Hodsock and 22·0° at Coston Rectory, on the 14th; 23·0° at Henley-in-Arden and 23·6° at Loughborough, on the 5th; 27·0° at Strelley, on the 4th and 5th. On the grass, 15·0° at Hodsock, on the 4th; 17·5° at Loughborough, on the 5th; 17·7° at Strelley, on the 2nd. Rainfall was rather above the average, the totals varying from 1·94 to 1·47 inches, and the number of "rainy days" from 16 to 13. The greatest fall was 0·56 inch, which was the value at Loughborough and Henley-in-Arden on the 1st. Sunshine was about the average. The wind was moderate in force and of variable direction. A lunar halo was observed at Loughborough on the evening of the 27th. The cuckoo was heard at the close of the month. Swallows were seen at Henley-in-Arden on the 17th.

12, Victoria Street, Loughborough. Wm. Berridge, F.R. Met. Soc.

Natural History Notes.

The Flora of the Lake District.—We are pleased to be able to announce that Messrs. Bell and Co. have just published "A Flora of the English Lake District," by J. G. Baker, F.R.S., F.L.S. This very excellent work contains a record of about fifty ferns and 850 flowering plants, native of the Lake district; together with about 100 recent additions, and valuable introductory matter relative to citizenship, the range and the type of distribution of the plants enumerated. There is also a truly interesting Bibliography of the Lakeland district. The eminent position as a botanist enjoyed by the author of this Flora ensures its being an able and correct record of the botanical wealth of one of the most classic and romantic districts in England, and will ensure for it a wide circulation among all who are interested in the study of British botany.

Sparrows *versus* Starlings.—The impudence of sparrows is proverbial, but I do not remember to have noticed until lately sparrows attending upon starlings that were collecting worms to feed their young and when opportunity occurred seizing hold of the worms and pulling them out of their beaks. It looked very ridiculous to see a starling waddling along with its insecure gait, poking its long bill here and there into the grass, and now and then a struggle for the spoils. In one instance I noticed five sparrows following, and the starling was fairly driven away. Sparrows peck away on the lawn incessantly, but I was not aware that they eat worms, as they do not pull them up as robins do. I remember that some years ago there was a controversy in the "Zoologist" as to whether starlings poked their open beaks into the turf; I agreed with my relative, the late Edward Newman, that they did, and do not see any reason to change

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my opinion. A thrush or a blackbird seizes hold of the worm and pulls it out by leverage, but a starling pushes his bill into the ground on either side of the worm and pulls it out or bites it off with one effort. The quantity of worms I have noticed the starlings take to their young is very great—backwards and forwards all day long. I have not noticed sparrows attack blackbirds or thrushes when collecting.—Wm. Southall.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SCCIETY.—General Meeting, April 28th.—The retiring President (Mr. T. H. Waller, B.A., B.Sc.) read an address, which will appear *in extenso* in the "Midland Naturalist." Mr. R. W. Chase exhibited a male specimen of *Somateria spectabilis*, the King Eider, shot at the Farne Islands, Northumberland. This bird is rarely seen in Great Britain, its home being in the Arctic regions. Mr. A. Browett exhibited the common viper or adder, *Vipera ferus*, from Bournemouth, and a flower spike of *Aponogeton distachyus*.—General Meeting, May 5th.—Mr. T. Bolton exhibited *Volvox globator*, with the rotifer *Notomata parisitica* living inside it, and *Phalansterium digitatum*, from King's Norton, an infusorian new to Great Britain. —Biological Section, May 12th. Mr. W. H. France in the chair. —Mr.J. E. Bagnall, A.L.S., exhibited and described the following:—*Taraxacum palustre*, *Cardamine amara*, and *Carex præcox* from Arbury; *Nasturtium amphibium*, *Alisma lanceolatum* from Griff; mosses, *Didymodon flexifolium*, new to Warwickshire, from Atherstone; *Eurhynchium striatum*, *E. piliferum*, *Tortula lævipila*, *Hypnum chrysophyllum*, *Fissidens exilis*, *Campylopus pyriformis*, and other mosses from the Anker basin. Also a peculiar abnormal state of one of the agarics, in which a group had been transformed or degenerated into a mass of beautiful purple filamentous threads, found growing on a block of wood in a drain in Buckingham Street. For Mr. J. T. Slatter, of Evesham, the morrel, *Morchella esculenta*, one of the esculent fungi, found near Redditch. Mr. T. Bolton, F.R.M.S., *Volvox globator*, infested with the rotifer *Notommata parasitica*; *Rhinops vitrea*, from King's Norton; and *Limnocodium Sowerbei*, the fresh-water medusa.—General Meeting, May 19. Mr. Waller exhibited a method of cleaning No. 1 microscopic glass covers. Mr. Bolton exhibited *Syncoryne frutescens*, the living hydrozoa, with the medusoid planoblasts attached and free. Mr. W. B. Grove, B.A., read a paper by Mr. Francis Fowke, F.R.M.S., on "The First Discovery of the Comma Bacillus of Cholera," accompanied by photographs, and a number of impressions of similar objects from engravings on wood. Mr. Fowke claimed that two English doctors, Messrs. Brittan and Swayne, had discovered the Bacillus of Cholera during the epidemic of 1849, and figured it in a journal of that time. Mr. Grove regretted that he was unable to agree with Mr. Fowke in according to the English observers the right of priority. The sketches given by them bear no indication of their scale, but, making a guess at that from the other particulars given, it will be seen that they represent objects much larger than the Bacillus; moreover, the drawings do not in any case resemble the Bacillus, which never forms rings, and, when septate, is widely different from the only figure they give in which the septa are shown.—Sociological Section, May 7th. The President, Mr. W. R. Hughes, F.L.S., read Chapters IV. and V. of Mr. Herbert Spencer's "Study of Sociology," viz., on the "Difficulties of the Social Science"

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and "Objective Difficulties," interspersed at intervals with valuable disquisitions and instructive explanations, to which all present contributed. May 21. Mr. W. R. Hughes, F.L.S., in the chair. Miss Naden ably read and expounded Chapters XI. and XII. "Direct equilibration" and "Indirect equilibration" of the 3rd part of Mr. Herbert Spencer's "Principles of Biology." A very interesting discussion on the many intricate biological problems introduced, followed the paper, in which the President, Dr. Hiepe, Mr. W. H. France, Mr. F. A. Walton, and Miss Naden took part.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—April 20th. Mr. J. W. Neville showed various specimens of helices from Spain; Mr. Madison, a singularly distorted specimen of *Clausilia rugosa* from Hamstead; Mr. Deakin, a pair of Emperor Moths and eggs of the same. Under the microscope, Mr. Moore exhibited stomach, malpighian tubes, &c., of *Pulex irritans*; Mr. J. W. Neville, *Volvox globator*, A paper was then read on practical microscopy, "Mounting in Glycerine," by Mr. H. Insley, which described the advantages of glycerine as a mounting medium more particularly for botanical objects, and also some of the difficulties attending the use of glycerine jelly and Deane's gelatine. The process of preparation was then shown and the mode of securely sealing the cover glass described.—April 27th. Mr. Tylar exhibited specimens of silver ore from Utah; Mr. Madison, a collection of caddis cases typical of the district; Mr. Hawkes, specimens of a fungus *Peziza cyathoidea*. Under the microscope, Mr. Moore showed lancet and suctorial organ of *Pulex irritans;* Mr. J. W. Neville, palate of *Nassa reticulata*.—May 4th. Mr. Moore exhibited specimens of *Paludina contecta*, and *Helix rotundata* var. *alba*, the latter from Great Barr; Mr. Hawkes, the following fungi :—*Puccinia Saxifragarum*, *P. Ægopodii*, and *Æcidium ranunculacearum*. Under the microscope, Mr. Dunn showed eggs of cypris; Mr. J. W. Neville, mouth organs of mosquito; Mr. Hawkes, slides of entomostraca, desmids, and diatoms from the digestive organs of small fish.—May 11th. Mr. Madison showed a number of distorted specimens of *Limnæa peregra* from near King's Norton. Under the microscope, Mr. Moore, hair of white mole; Mr. Beale, eggs of *Gobius niger*, with advanced embryo; Mr. Hawkes, the buttercup mite, *Bryobia haustor*.—May 18th; Special—Geology. A large collection of carboniferous fossils was placed upon the table, made by the members in the Bentley district during an excursion on the previous Saturday afternoon. Mr. Insley showed polished specimens of *Favosites gothlandica*, and a slab of Lower Lias containing fish remains, the latter from Lyme Regis; Mr. Madison, large specimens of *Unio tumidus*, and some varieties of *Anodonta anatina*; Mr. Hopkins, a white variety of *Limnæa stagnalis* from Barnt Green. Under the microscopes, Mr. Moore showed sections of Devonshire corals; Mr. J. W. Neville, section of *Heliolites interstinetus*; Mr. Hawkes, *Draparnaldia tenuis*.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —Section D.—Zoology and Botany.—Chairman, F. T. Mott, F.R.G.S. —Monthly Meeting, Wednesday, May 20th. Attendance, ten (one lady). Election of officers for the ensuing year: Chairman, F. T. Mott; Hon. Secretary, C. W. Cooper, M.D., in the place of Mr. J. H. Garnar, who desired to resign, to the great regret of the Section, by whom his valuable services for the past two years were much appreciated. The Chairman reported that at the Field Day on the previous

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Wednesday five members went to Kirby Muxloe, examining the ruins of the castle and surrounding district, and two others visited Syston for the purpose of procuring a number of specimens of *Petasites vulgaris*. At Kirby were found *Lilium martagon*, *Polygonum Bistorta*, *Vinca minor*, *Myosotis collina*, &c., growing in various parts of the old inclosure and about the ruined walls; several of them perhaps relics of a garden all traces of which are now lost under a uniform green turf. Rooted in the foundations of what was once a wall, and hanging far over the weedy moat, was a large bush of *Cornus mascula*, with a stem three or four inches in diameter, and the branches loaded with the curious umbels of young fruit. This shrub is not a native of Britain, but was introduced from Europe about three hundred years ago, and is described and figured by Parkinson in his "Theatrum Botanicum," published in 1640. This also is probably a descendant of what was planted long ago as a choice novelty. On the banks of the moat were *Lunularia vulgaris*, *Neckera complanata*, *Barbula fallax*, and other hepaticæ and mosses. The party who went to Syston brought back a number of flower-spikes of *Petasites*, all of which proved to be the sub-male form. The sub-female, however, which is said to be comparatively rare, has been found in several districts of the county. The Evening Meeting was devoted to the exhibition of specimens and to general discussion; there was no paper. The following objects were exhibited:—By Dr. Finch, several admirable slides of the Bacilli of Anthrax and Tuberculosis, mounted by Dr. Buck, and well shown by Mr. Garnar, with a power of about eight hundred; by Mr. E. F. Cooper, F.L.S., slides of the male and female flowers of *Petasites vulgaris*, and a specimen of the rare *Lamium intermedium*, new to this county; by Mr. W. A. Vice, fruits of *Liriodendron*, *Catalpa*, *Juglans nigra*, *Laurus Sassafras*, *Platanus*, &c.; a bunch of the remarkable epiphyte, *Tillandsia usneoidea*, from the West Indies, looking like a mass of tangled twine; two kinds of American oak-galls, one a single cell, the other an aggregate of cells; and specimen plates of Mr. F. W. Kirby's new Text Book of Entomology, published by Swan Sonnenschein and Co., which was particularly interesting to the members, Mr. Kirby being a Leicester man; by Mr. W. E. Grundy, capsules of the cotton plant, *Gossypium;* ripe fruit of the castor oil plant, *Ricinus communis;* and well mounted slides of the peristome of *Mnium hornum*, and several algæ; by the Chairman, fresh flowers of the curious umbellifer, *Dondia Epipactis;* the summer snow-flake, *Leucojum æstivum;* and the wild cowslip grown in good garden soil, showing the large clusters of flowers and the tendency to proliferous growth which is a common effect of cultivation on this plant; dried specimens of the large common sea weeds *Fucus vesiculosus*, *serratus*, and *nodosus;* *Laminaria saccharina* and *digitata;* also of *Polysiphonia fastigiata*, showing under the microscope the peculiar and elegant structure of this genus; and the floating gulf weeds *Sargassum vulgare* and *baccifernm*; also a series of marine shells, *Oliva*, *Conus*, *Murex*, *Trochus*, *Cerithium*, *Cypræa*, &c., showing the characters which distinguish mature from young shells, the marks indicating periods of growth, the peculiar nature of porcellanous shells, and the difference between the entire mouth of the herbivorous species and the canaliculated mouth of the carnivorous ones. The Society having decided to apply under the new rules of the British Association for recognition as a Corresponding Society, the Chairman urged upon the members of the section the necessity of earnest work, especially upon local zoology and botany, in order to maintain the position and reputation of the Society.

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MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

ANNUAL MEETING AT BIRMINGHAM, JUNE 16TH, 1885.

ADDRESS BY MR. R. W. CHASE, PRESIDENT OF THE UNION.

At the annual meeting of the Midland Union of Natural History Societies it is the not unpleasing duty of the President to deliver an address. Considering the somewhat festive character of our annual reunion, an abstrusely scientific paper would probably be unwelcome to the majority of my hearers. Indeed, I would ask you not to expect a learned discourse from me, for I have had no scientific training which would fit me to deliver one, and there are many present who are, I am sure, better qualified to give an address than to learn anything from me.

I have taken up only one branch of Natural History, viz.: Ornithology, and that entirely in the position of an amateur. The principal reason why I have chosen that especial branch is, that birds seem to attract one's notice more than any other members of the animal kingdom, frequenting, as they do, all the haunts of man. To this science I will ask your attention for a short time; but before enlarging upon it I should like to make a few remarks upon the work done by the Union.

In looking through the list of those Societies forming the Midland Union, and considering the large number of members composing the same, amongst whom will be found many well known as votaries of Natural Science, I am astonished that such a considerable amount of individual labour should be undertaken—which I know to be the case—and that yet the result in the aggregate should be so small.

I think it would be an advantage if at the annual meeting of the Union a special line of study or research could be decided on, so that the accumulated knowledge might be published: a course which would greatly benefit future students. No doubt the chief drawback to a plan of this kind is the jealousy which frequently exists between students of the same subject, and prevents them from working harmoniously together; but this rivalry, if properly exercised, would cause healthy emulation and consequently greater efficiency.

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I also wish to call attention to what may be aptly termed economic natural history—I mean the study of such creatures as are injurious to agriculture—with a view to work out their life history, and if possible to point out the best method of preventing their depredations; to distinguish the non-injurious from the injurious kinds, and so to prevent the sacrifice of many innocent victims to popular ignorance or prejudice. A good work of this description is being done by Miss Ormerod on behalf of the Royal Agricultural Society, and I feel sure that many of our county Natural History Societies might follow in her footsteps, both to the advantage of the farmer and to the credit of the society.

The compilation of local lists of the fauna and flora ought to be undertaken by the different societies in their respective districts and published under their auspices. Such lists would form valuable works of reference, and be of incalculable use in future years. Should such work be decided upon no delay ought to take place, as in all probability many of our animals and plants which are still to be found in localities suitable to their respective habits will in a short time become extinct. This is especially true of many of our rarer ferns, which in some districts could be found growing plentifully a few years back, but are now only conspicuous by their absence, which is principally due to the depredation of tourists and exchange clubs. I remember a spot in Hants where *Osmunda regalis* grew so plentifully that the labourers used to cut the fronds for litter; but owing to the demand for specimens the place is now cleared.

I think the amalgamated societies might well raise their protest against such proceedings, and I feel confident that unanimous action on their part would have a satisfactory result.

The principal utility of Natural History Societies, in my opinion, is the finding of employment for the leisure hours of those who are engaged in commercial or other pursuits. In this way the Birmingham Natural History and Microscopical Society has been of great service to me. The recreation to which membership of such a society leads is not only deeply interesting and instructive, but practically affords the greatest amount of rest, inasmuch as different muscles are called into play, while the mind is differently occupied. This change of function produces a great feeling of rest, far greater than that which results from sitting in an armchair, doing nothing, which to me is a state of semi-torture; and it is from this point of view that I have taken up Ornithology as my hobby.

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I have confined myself chiefly to the study of British birds, because I think a man ought to be thoroughly conversant with the Natural History of his own country before undertaking that of foreign lands, as a resident has a much better opportunity of studying the life history of any species than he possibly can have when travelling through a strange country.

The Bibliography of Ornithology is most voluminous, but the majority of works are simply compilations from previous authors, and in many instances multiply their errors. I trace the cause of this to the fact that it is impossible for one man to personally investigate the life of all the species of which he gives an account; therefore I strongly advocate the publication of monographs instead of works comprising all orders of birds. The beautiful woodcuts of Bewick gave a great impetus to the study of Ornithology, and the reason why his drawings caused such admiration was that in most cases the drawings were made from life instead of from stuffed specimens, which had been the case in most of the previous works. Since the days of Bewick the art of lithography has been brought to a great state of perfection, and now that we have works illustrated like Gould's, or Sharpe and Dresser's, little is left to be desired. The only improvement I could suggest would be the illustration of the intermediate stages and young birds, instead of the finest adult specimens that can be conceived, which are well known, whereas many birds of the year, or those undergoing partial change of plumage, are little known or appreciated; indeed I have known instances where such birds have been thrown away as not worth preserving, because not adult, though in my opinion such specimens are actually more interesting.

Yarrell's "British Birds,"—of which a fourth edition is now being published—with McGillivray's accurate and observant work, will be found sufficient to give a student a very fair knowledge of our native avi-fauna.

As there are two ways in which Ornithology can be studied I may consider it under two distinct headings, Indoors and Out-of-doors. No doubt a man sitting comfortably in his laboratory can, by the examination of dried skins, specimens in spirits, or the anatomical structure and the formation of the digestive organs of birds, obtain a large amount of knowledge, and with some degree of certainty assign each individual species to its proper family and genus, whatever system of classification he may be following, until he imagines that he has discovered the natural affinity, and forthwith publishes a new system, making confusion more confused, forgetting that there is a marked difference between

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affinity and analogy, the one being a natural, the other only an artificial arrangement and liable to error, as in Nature all things are perfect in my opinion. This method also leads to multiplication of synonymous names and cannot be too deeply deplored.

I have occupied many hours in studying the Morphology and Physiology of Birds and know of few more beautiful things than the skeleton of a bird, combining as it does strength and lightness with perfect adaptability for the purpose it was designed.

The digestive organs have provided me with a large amount of interesting study, varying as they do in a considerable manner according to the food upon which the bird subsists. The examination of these organs will also show the exact substances which the bird was feeding upon. Only this last week I received from Norfolk two specimens of *Circus cineraceus* whose maws were full of the egg shells of various birds, and from the one, an egg of *Emberiza schœniclus* was taken out unbroken, proving clearly that this species swallows eggs whole. I make a point of preserving the contents of the stomachs in spirits when this is possible, and I find that even in closely allied species their food will often differ slightly.

This style of studying Ornithology may satisfy some people, but I felt that a great deal more knowledge and pleasure was to be obtained by investigating the life history and habits of our native birds as they are displayed in their natural habitats and in a living state. To do this necessitates some exertion and a considerable amount of time, because many of the breeding haunts of our most interesting species are situated in wild spots difficult of approach, but which when visited amply repay the enthusiast. Anyone exploring the Bass Rock would learn more of the natural history of *Sula bassana* in one hour than he would acquire from all the books he might read in a lifetime.

In order to become thoroughly conversant with the natural history of a bird you ought to know its habits, the manner in which it forms its nest, the situation in which it builds, and the localities which it frequents. These points are far more interesting to me than any classification, which I look upon as merely an assistance to memory.

One of the most interesting spots that I know for an ornithological visit is the Farne Islands, off the coast of Northumberland; you will find the various islands composing that group tenanted by their respective species in well-regulated colonies, and the manner in which they are

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governed might give some useful hints to our political economists. The following species will be found breeding upon these islands, which I have had the pleasure of visiting more than once :—Upon the wide opens Eider Ducks breed in considerable numbers ; with care you can approach within a few feet of the old ducks upon their nests, which they do not leave providing you keep still and make no sudden movements. In a small patch of nettles I should think there were quite ten or more nests. The males of this species undergo a considerable change of plumage before attaining the lovely dress of the adult. That rare bird, the King Eider, *Somateria spectabilis*, has been obtained on these islands twice, once in 1873, and again in this present year. This last bird is in my collection. I saw an example of this species two years ago, whether the same bird as the one I now have it is impossible to say.

The Arctic and Common Terns also breed plentifully upon the same island, the first named choosing the bare shingle just above high water mark, the latter preferring the top of the cliff amongst the short grass and sea campion. On the Knoxes will be found a colony of Sandwich Terns, which lay their eggs upon the bare sand, and you have to walk carefully not to crush the eggs, so closely are they placed together. I thought I never had seen a more beautiful sight when I saw these birds sitting on their eggs early one morning, but as soon as they were aware of my presence they rose in a flock, uttering their shrill cry.

The lovely Roseate Tern also occurs in small numbers, but has no separate breeding station as far as I know.

Puffins and Lesser Black-Backed Gulls, Oyster Catchers, and Ring Dotterels also breed on many of the islands. The Pinnacles, three detached rocks which stand a little way from the island of that name, are a charming sight when the summits are covered with Guillemots, amongst which a few Ringeyes are occasionally discernible, whilst the jutting points of the rock lower down are appropriated by the Kittiwake Gulls for their nests.

Perhaps the most striking spectacle is the Cormorant colony on the Megstone Rock, where the nests are placed on the summit in close proximity to each other, formed of coarse seaweed, some being two feet in height. I have a lively recollection of this breeding station ; upon my first visit, after climbing to the top, my foot slipped and I fell down into the odoriferous refuse surrounding these nests. It was some time before I could think of or imagine anything else but Cormorants.

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I was so struck with the beauty of bird life of these islands that I induced Mr. Green, of Berwick, to photograph the various colonies, with the birds on their nests, which he has done most successfully, and copies of the series no doubt he would supply upon application. I certainly claim the credit of originating the idea of photographing the birds in their breeding haunts at the Farnes. Since then Mr. Green has visited the Bass Rock, and has taken a splendid series of pictures of the Gannet.

The Broads of Norfolk are also well worth a visit. There you will find that fast-disappearing little bird *Panurus biarmicus*, the Bearded Tit; the large reed beds in that county forming its last strongholds. In May last year I had the opportunity of seeing this species breeding upon one Broad. It is rather particular in choosing the spot exactly suitable to its requirements, and to a casual observer many of the Broads seem equally suitable; but as this species breeds early in the year, before the reed has grown to any height, they choose the outlying skirts of the reed beds where last year's growth has not been cut, and place their nest close to the ground, amongst but not attached to the reed stems. The marshmen rob the nests time after time; the Tits at once nest again, and instances have been known where the birds have died upon the nest from sheer exhaustion—in fact, have laid themselves to death; even when the birds are allowed to rear a clutch, instead of eight or nine fine young birds hatched early in spring, only three or five are reared, and that so late that the young ones are hardly able to care for themselves before the cold weather sets in. During this same visit I also saw a flock of Ruffs (*Tringa pugnax*), which were associated with some Redshanks upon one of the marshes. I only saw one with his ruff fully developed, which was of rich black colour. Wild Ducks, Redshanks, and Lapwings breed plentifully in most of the fens; also a few nests of the Water Rail can be found in almost inaccessible places amongst the thick sedge.

The rarest nest I found was that of the Garganey Teal (*Querquedula circia*). The old bird flew from the nest almost under the feet of one of my companions, and the temptation being too strong, I pulled the trigger, and the Teal fell wounded. My friend, in his excitement to secure the specimen, went nearly up to his middle in a blind dyke. On Ormsby Broad the Great Crested Grebes (*Podiceps cristatus*) are very abundant. I counted over twenty in sight at one time.

The Scotch moors are well worthy of a visit, and you will find quite a distinctive class of birds in these wild and rugged districts. Some time ago, through the courtesy of

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the owner of a large shooting tract in Perthshire, I had the opportunity of seeing that splendid bird the Capercailzie (*Tetrao urogallus*), breeding on the summit of the pine-clad mountains. Accompanied by the keepers as guides, I arrived nearly at the top of the mountain, and before long had the pleasure of seeing a nest of this species, which was placed at the foot of a large pine, with a few dried leaves and sticks, simply an apology for a nest, and containing eight eggs. After a further search, I saw a fine male fly from a tree. He went with his head stretched out and tail slightly raised. Soon after a female rose, but I did not get a good view, and did not succeed in discovering her nest.

On the moors, of course, Red Grouse (*Lagopus scoticus*) are predominant, but Common Sandpipers (*Tringoïdes hypoleucus*) will be found breeding on the loch sides, also Curlews and Golden Plover. I took a nest of young, in down, of this last species, and more beautiful little creatures in their black and gold livery I never saw. The keeper and myself were watching a pair of old birds, when I heard "peep," "peep," close to me. Of course I at once instituted a search, and soon found one of the little fellows, and in a short time secured two more. They had run from the nest, and then crouched under a piece of heather or against a lichen-covered stone, trusting that their colour, assimilating with the surroundings, would prove a protection, but their voices and bright eyes betrayed their whereabouts.

There is a very interesting place a few miles from Towyn, called Craig-y-diren or Bird Rock, where some Cormorants for years past have taken up their abode during the breeding season, leaving again in autumn, and when we come to consider that this rock must be about six miles in a straight line from the sea, some idea can be formed as to the labour entailed upon the parent birds to feed a numerous family of young cormorants when their voracious appetites are considered.

In the Cader Idris range, Ravens, Buzzards, and Peregrine Falcons still continue to hold their own against the persecutions of gamekeepers and shepherds.

A visit to any of the places I have just sketched would teach more to a student than years of book-work, because in the first place Nature herself is his teacher, and secondly what he sees is so impressed upon his memory through being associated with many pleasant episodes that he never forgets such knowledge in after years.

One of the specialities of my collection (and every student must necessarily become a collector in his special branch of study, as he requires examples for examination and reference)

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is the manner in which my specimens are mounted. If a purely scientific arrangement is wished for, a collection should be formed entirely of skins, as being more convenient for examination and requiring less space to store. The stuffed abortions in the majority of our museums cannot give a student the slightest idea of what the bird is in life; rows upon rows of these mummies are placed upon turned stands, all of one pattern; and whether the bird in life would frequent rocks, trees, sea coast, or marshes, it matters not; they are all placed in like circumstances in the glass cases.

In my collection I have endeavoured to reproduce as far as possible the natural habitat of each species, employing surroundings to denote the locality which the species would frequent. Moreover I have shewn the life-history from the young to the adult where possible, and thanks to the improvement of late years in taxidermal art, birds can be made to look perfectly natural, lacking only vitality, which it is impossible to give.

Many collectors I know consider that the bird ought to be the most conspicuous object in the case without any surroundings, as in their opinion they detract from the specimen itself, but I hold that a collection of skins, which I mentioned before, is preferable to specimens mounted in this style. Of course I am well aware that the surroundings can be overdone; the bird itself *should* be of the first importance, but if judicious treatment of the accessories be shown, they rather add to than detract from the appearance of the bird. I shall exhibit in the Town Hall this evening some of cases representing the class of work and system I am endeavouring to carry out.

Many of the auxiliaries in the mounting of the specimens, such as sand, shingle, grasses, &c., also rocks and stones from which the models have been taken, were procured from the same spots as the birds themselves.

I am happy to say that a portion of our national collection, under the care of Mr. R. B. Sharpe, F.Z.S., is being mounted in a somewhat similar manner. Probably many here present have had the pleasure of viewing these new cases in the galleries of South Kensington.

It may be thought by some that our immediate district is rather a poor locality in which to study Ornithology, but if I had time to read over some of my notes, I think the number of species of birds to be found in the neighbourhood of Birmingham would astonish my hearers; but this only goes to prove what I have long contended, that it is not objects and specimens in any locality that are deficient, but Natural History students to discover them.

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Natural History, I venture to say in conclusion, is one of the most rational hobbies a man can take up; it brings him in direct contact and communication with Nature; it improves his health and elevates his mind, and, whatever branch he may undertake to study, he will find that honest work never fails of its reward.

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

PART I.

BY BEEBY THOMPSON, F.C.S., F.G.S.

(Continued from page 152.)

BED "K."

This bed is a sandy clay or shale, highly micaceous, varying in colour from grey to light reddish brown, according to the amount of weathering it has undergone. At *Chalcomb* the joints and surfaces are red, and there is a thin line of small concretionary ferruginous nodules. The light-coloured specimens do not effervesce with acids, and the grey ones only slightly. The material of the bed seems very pervious to water, and when it is wet it readily crumbles down. In consequence of these properties most of the fossils are only casts, and they are preserved with difficulty unless the material is dry when they are extracted, but they are rather abundant. The thickness of this bed appears to be about 6ft. At *Chalcomb* it measures 5ft. 7in., *Staverton*, 5ft. 9in. The fossils in this bed so nearly agree with those in the two beds above it that I have not thought it necessary to give separate lists.

BED "J."

This bed differs very little in appearance and fossils from the two softer beds between which it occurs. It is yellowish brown in colour, micaceous, and ferruginous where I have found it, and when specimens of it are placed side by side with others from the beds immediately above and below it they are scarcely distinguishable without an appeal to the hardness. The hardness appears to be due to carbonate of lime, at least there is no other evident cause for it. Although this bed is so nearly like the two between which it is placed, and is probably not persistent over any large area, I have found it useful in giving an idea of the development of the Middle Lias beds, where the softer beds are covered up—on

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the grassy slopes of a railway bank, for instance. The thickness of this bed is about 2ft. at Staverton, and nearly 3ft. at Watford.

Bed "I."

The number of sections in which this bed can be seen is very limited, but it appears to be almost exactly like the bed "K." I have only been able to actually measure it at one place, Staverton, and there it has a thickness of 4ft.

List of Fossils from Beds "K," "J," "I."

Ammonites margaritatus... Chalcomb, Milton, Newnham.
Belemnites ..... Milton.
Ostrea submargaritacea.... Chalcomb.
Ostrea sportella ..... Milton.
Ostrea cymbium ..... Milton.
Pecten æquivalvis..... Chalcomb, Milton.
Pecten liasinus (small) ... Chalcomb, Staverton, Watford, Newnham.
Limea acuticosta... ..... Chalcomb, Staverton, Watford, Newnham.
Plicatula spinosa..... .... Milton (abundant).
Avicula inæquivalvis..... Chalcomb, Milton (abundant).
Modiola subcancellata (?).. Chalcomb.
Modiola numismalis (?).... Chalcomb.
Protocardium truncatum .. Chalcomb, Milton, Staverton, Watford.
Cardinia antiqua ..... Milton (abundant).
Astarte striato-sulcata..... Chalcomb.
Pholadomya ambigua..... Chalcomb, Newnham.
Arca liasina..... Chalcomb, Watford.
Arcomya hispida..... .. Chalcomb.
Unicardium globosum..... Chalcomb.
Pleuromya costata..... .. Milton, Chalcomb.
Pleuromya granata (?)..... Milton.
Encrinite stems..... Milton, Staverton.
Fucoid markings..... Staverton, Watford.

Bed "H."

The general character of this bed is that of a soft red sandstone abounding in fossils. It appears to be micaceous and calcareous in some places and not in others; also it varies considerably in the amount of iron it contains, and in the relative abundance of certain fossils. The bed may be best examined at Byfield, Staverton, and near Daventry. At *Byfield* it is 3ft. 3in. in thickness, and is a homogeneous red sandstone containing two or three species of *Pholadomya*

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in abundance, together with a fair number of specimens of *Protocardium truncatum* and *Pleuromya costata*. At *Staverton* it is almost an ironstone, and somewhat cellular in structure; Pholadomyas are not so common, but *Protocardium truncatum* more so. I believe the latter fossil is more common in this bed than in any other bed of the Middle Lias of Northamptonshire. It is found in masses—somewhat like *Rhynchonella tetrahedra* in the Rock bed—at certain places. Thickness at Staverton, 2ft. 9in.

Fossils.

Ammonites margaritatus... Byfield.
Ostrea cymbium..... Staverton.
Pecten liasinus..... Byfield.
Limea acuticosta..... Byfield.
Avicula inæquivalvis ... ... Byfield, Staverton.
Arca elongata..... Staverton.
Modiola numismalis..... Byfield.
Protocardium truncatum... Byfield, Staverton, &c.
Cardita multicostata..... Staverton, Byfield.
Pholadomya ambigua..... Byfield, Staverton.
Pholadomya Simpsoni..... Byfield.
Pholadomya obtusalis..... Byfield.
Pleuromya costata..... Byfield, Staverton.
Arcomya concinna (?)..... Staverton.
Ceromya petricosa..... Byfield.
Goniomya heteropleura.... Byfield.
Isocardia liassica (?) ..... Byfield.
Pentacrinite stems ..... Staverton.
Wood, and cavities left by stems of plants..... Byfield, Staverton.
Calc spar—a little..... Byfield.

Bed "G."

This bed is a micaceous sandy clay or marl, of a dark blue colour when first exposed, but getting much lighter coloured on exposure; it appears to contain fewer fossils than any of the beds below it. There was a very good exposure of it near to *Byfield* during the making of the East and West Junction Railway, where it was found to measure 6ft. 2in. It may be seen at *Staverton*, but it is so situated that I have not been able to measure it. It is probably between 6ft. and 7ft. in thickness near *Northampton*. I have found no fossils in this bed that are not also in the beds both above and below it.

Bed "F."

A soft, sandy, ferruginous limestone, generally shaly, and very fossiliferous, some parts being made up of comminuted

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shells. The fossils in this bed are better preserved than in any of the beds at present described, except "L." *Ammonites margaritatus* and *Pleuromya costata* are particularly abundant at Byfield. The best places for examining it are near to *Byfield* and *Watford* respectively. At each of these places it has a thickness of about 3ft.

Fossils.	
Ammonites margaritatus...	Byfield.
Ammonites margaritatus, var. submodosus.....	Byfield.
Belemnites.....	Byfield, Watford.
Chemnitzia (sp. ?).....	Watford.
Turbo aciculus.....	Byfield.
Ostrea cymbium.....	Byfield, Watford, &c.
Ostrea sportella.....	Byfield.
Pecten æquivalvis.....	Byfield, Watford.
Pecten liasinus.....	Byfield, Watford.
Limea acuticosta.....	Byfield, Watford.
Plicatula spinosa.....	Byfield, Watford.
Avicula inæquivalvis.....	Byfield.
Pinna (sp. ?).....	Byfield.
Inoceramus substriatus....	Byfield.
Modiola numismalis.....	Byfield.
Protocardium truncatum...	Byfield, Watford.
Cucullæa transversa.....	Byfield.
Unicardium globosum.....	Byfield.
Astarte striato-sulcata.....	Watford.
Cardita multicostata.....	Byfield, Watford.
Pholadomya ambigua.....	Byfield, Watford.
Pleuromya costata.....	Byfield, Watford.
Pleuromya (sp. ?).....	Byfield.
Arcomya hispida.....	Byfield.
Cardinia lævis..... ..	Watford.
Serpula.....	Byfield, Watford.

(To be continued.)

A SUCCESSFUL POND HUNT.

BY THOMAS BOLTON, F.R.M.S.

On Saturday afternoon, May 2nd, the President of the Birmingham Natural History and Microscopical Society took me to a small farm at King's Norton "ponderneering," as a friend of mine calls it; nearly every field on the farm contained a small pool or marl-pit, and I think it may interest your readers to give an account of my collections.

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In the first pool I saw at a glance that there was a promise (afterwards confirmed) of Spirogyra in conjugation, which I wanted for a botanical class. The water was also full of Entomostraca, watermites, and beetles.

The second pool we visited was thick with *Volvox globator*, amongst which were plenty of *Diaptomus castor* and the larvæ of *Corethra plumicornis*, the glass-larva, which latter wonderfully transparent larva, with its curious kidney-shaped air-vessels in its chest and tail by which it floats horizontally, was abundantly found in nearly all the pools.

From the last and one of the largest pools I was glad to pull out some transparent Nitella, which proved to be *Nitella flexilis*, not, I think, previously recorded for Worcestershire. I could see that it was nicely covered with various living animals, and the first dip from this pool showed that the water was thick with countless numbers of the Infusorian, *Peridinium tabulatum*. I then threw in my drag and pulled out some of the Potamogeton, which I found to be bristling with the universal favourite of microscopists, the wonderful building Rotifer, *Melicerta ringens*.

I was well pleased with my visit, and could see with my pocket lens that there were many free Rotifers and Infusoria, too small to identify without the more powerful table microscope; so when I called at my studio on my return to deposit my collections I took a hasty glance at the Nitella, and soon found amongst a host of interesting organisms a beautiful *Flosculuria longicaudata*, which was discovered near Aberdeen for the first time by Mr. Hood in 1871 (see "Royal Microscopical Society's Journal," 1873), and which has not previously been recorded in England. I could with pleasure have studied this little bit of Nitella, and the inhabitants that clothed it, for hours, but it was so late that I was obliged to defer further examination of it. On Monday I was pleased to find an Infusorian I had not seen before, *Phalansterium digitatum*, which Mr. Saville Kent reports in his Manual of the Infusoria as not having been discovered in Great Britain; his description and figure were copied from the German publication of Stein. The small zoophyte trough in which I have discovered this has remained unchanged in the Society's library ever since, forming a diminutive aquarium, and a good part of the organisms enumerated below I have seen in this small portion of my gathering.

As we were walking round, the gentleman holding the farm told us the cattle in the neighbourhood suffered from the fluke, so I at once looked for the water snails, which usually form the intermediate host, giving out the *Cercaria* which

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the sheep or cattle devour with the grass. I did not find a single specimen then, but have since found in a pool on a neighbouring farm an abundance of *Limnæa stagnalis*, with quantities of that same *Cercaria* which I have shown before as parasites of this snail, and of which I have given a sketch in my Portfolio, No. 6.

At the time I issued that sketch I was under the impression that this was the *Cercaria* of the sheep fluke, *Fasciola hepatica*, but Mr. A. P. Thomas, in his exhaustive account of the life-history of this parasite in the "Quarterly Journal of Microscopical Science" (January, 1883), states that that species cannot exist in *Limnæa stagnalis*, and that its usual host is a much smaller species, *Limnæa truncatula*.

On comparison of my sketch with Mr. Thomas's figures they will be found to differ, I think, sufficiently to suggest that this is another species, and it would be well if some one would work out its life history, as it is quite possible that the *Cercaria* from *Limnæa stagnalis* may be the larval form of the fluke of the cattle.

LIST OF ORGANISMS COLLECTED.

Nitella flexilis (in fructification).
Spirogyra (in conjugation).
Bulbochæte.
Volvox globator.

Uroglena Volvox.
Phalansterium digitatum.
Vorticellæ (various).
Carchesium polypinum.
Epistylis grandis.
Stentor cœruleus.
Cothurnia imberbis.
Vaginicola tincta.
Thuricola valvata.
Platycola decumbens.
Peridinium tabulatum.
Amphileptus meleagris.
Chætogaster diaphanus.
Nais —— ?

ROTIFERA.

Chætonotus larus.
Floscularia cornuta.
F. longicaudata.
Stephanoceros Eichhornii.
Melicerta ringens.
Cephalosiphon limnias.
Notommata parasita.
Rhinops vitrea.
Triarthra longiseta.
Mastigocerca carinata.
Metopidia acuminata.
Euchlanis triquetra.
Salpina mucronata.
Rotifer macrurus.
Philodina megalotrocha.

Tardigrada.
Plumatella repens (emerging from the statoblast).

MORCHELLA SEMILIBERA, DC.—This somewhat rare fungus was gathered at Eaton Constantine, near Shrewsbury, by Mr. W. E. Beckwith, in the beginning of May last. This is the first record of its occurrence in Shropshire.—W. PHILLIPS, Shrewsbury.

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PENNATULIDA.

MICROSCOPIC SECTIONS AND THE MODE OF AUTOMATIC SECTION-CUTTING AND MOUNTING.*

BY W. P. MARSHALL, M.I.C.E.

The preparation of the objects for section-cutting by hardening, staining, and imbedding is the same as usual; the special points to be described are the method of cutting the sections and of mounting them.

The sections are cut by an automatic machine, which performs the operation with great rapidity, as many as 100 sections being cut per minute, and with such absolute uniformity and regularity that the successive sections as they are cut adhere together by their edges, following close after one another, so as actually to form a continuous ribbon of one or two feet in length. This ribbon is then divided into about 2½ inch lengths, suitable for mounting on the ordinary three inch glass slides, three separate rows of the sections being often got upon a single slide. The special practical advantage arises from this, that the very large number of these sections, each only $\frac{1}{1000}^{th}$ or $\frac{1}{2000}^{th}$ inch thickness, that are required to make up a complete object, can be all conveniently contained upon only a few slides; also all these sections are retained strictly in their correct consecutive order for proper examination of the structure of the object. In the case of the Funiculina slides now exhibited, there are as many as fifty separate sections on a single slide, and the total number of 270 sections that is required to complete the set of sections of a single polype from one extremity to the other is contained upon only six slides.

The process of preparing an object for section-cutting is first to harden or toughen it sufficiently to stand the subsequent imbedding without distortion or displacement, and then to imbed the object in paraffin for giving firm support to it during the operation of cutting the sections.

The object is taken from the ninety per cent. alcohol in which it had been previously kept, and in which it can be safely kept any length of time till wanted for preparing, and is then hardened by soaking in a weak solution of picric acid or chromic acid, the strength of acid and time of soaking being varied according to the delicacy of the object. The object is then transferred to absolute alcohol for getting rid of all traces of water, and at this stage it is in most cases stained by hæmatoxylin or other reagents for the purpose of

* Transactions of the Birmingham Natural History and Microscopical Society. Read at a Meeting of the Society, April 21st., 1885.

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distinguishing clearly the transparent tissues in the sections. In the case of the Funiculina and Pennatula polypes, which both contain a number of hard calcareous spicules, these have also to be decalcified before the sections can be cut, by soaking the object in very dilute hydrochloric or nitric acid for a week or fortnight; a very gradual process being desirable in order to avoid any evolution of gas in the tissue that might cause some rupture or displacement.

The object is then imbedded in paraffin in a small paper trough or mould, not larger than enough to insure a margin of paraffin of not less than $\frac{1}{8}^{th}$ inch on all sides beyond the object. Some melted paraffin is poured into the mould, the object is laid centrally upon this, and the mould filled up with melted paraffin; the whole is then exposed to a uniform temperature of 130° or 140° Fahr. in a soaking chamber of a water-oven for a whole day, for the purpose of getting the paraffin thoroughly to permeate the tissues of the object. This is a point of special importance, as it is requisite to have the whole like a thoroughly solid block of paraffin in order to obtain sound unbroken sections. Also it is necessary to employ paraffin of the exact degree of hardness and stiffness according to the temperature of the room in which the section-cutting is to be done, that will give sections tough enough not to break, and soft enough to stick together at their edges, without being so soft as to stick to the razor, which is used quite dry and clean. This point is obtained by selecting the paraffin from several different qualities, which can be obtained having melting points at different temperatures, and varying the selection according to the seasons of the year and circumstances of the room. This plan is found, with a little practice, to yield the most satisfactory results, the material being homogeneous, and working better in the cutting than any mixture of oil or other material with the paraffin to modify its hardness.

A holder is then made for the object whilst being cut, by a small brass tube as a mould, closed at the bottom with a cork, and filled with melted paraffin, into which, when set, the little paraffin block containing the object is fixed by making a central cavity with a hot wire, and bedding it in solid by melting the paraffin around it with the hot wire, leaving the little block projecting partly at the top. The projection is pared away carefully until the imbedded object is seen to be near the surface, and the sides are pared away into a square form with parallel sides, leaving only such a margin at the sides beyond the object as is found by experience to supply sufficient strength to the sections to hold together when cut, without incumbering them with any superfluous

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quantity of paraffin. It is important for the sides to be cut parallel in order to get the successive sections to stick together properly for forming a continuous ribbon.

The razor blade by which the sections are cut is in the machine made a fixture, and the object to be cut is moved to and fro against the blade; instead of the object being stationary and the blade moved, as in section-cutting by hand. The use of this is to obtain a continuous unbroken series of sections forming a continuous ribbon, which passes across the blade, and is received upon a travelling band that moves forward at the same rate as the sections are cut, standing still during the return motion of the sliding block that carries the object back in preparation for the next cut. The object holder is supported by a screw of fine pitch which has a ratchet wheel fixed upon its head, and in each return stroke of the sliding block this ratchet wheel meets a catch which turns it round one or more teeth, according to the desired adjustment, and thus advances the screw to raise the object the thickness of the next cut. This can be adjusted so that the thickness of each section is uniformly $\frac{1}{1000}^{th}$ inch or $\frac{1}{2000}^{th}$ inch, or otherwise as may be desired. The driving wheel is either turned by hand, or it can be driven by power by means of a band round the circumference of the wheel. It is readily driven by hand at the rate of 100 sections cut per minute, and can be driven by power at a higher rate without difficulty, and the quick motion is advantageous to the perfect condition of the sections.

For the mounting of the sections, the glass slide is first covered with a thin film of collodion, mixed with an equal quantity of oil of cloves, which is dropped on the slide and levelled by a needle held flat across the slide, and stroked down its whole length. The ribbon of sections is cut into lengths to suit the slide, and the pieces dropped on to the slide, guided by a needle, in two or three rows, according to the width of the sections, and they adhere firmly upon the collodion film. The slide is then exposed to a uniform heat of 130° to 140° Fahr. for half a day to soften the paraffin and make it readily soluble in turpentine, and the whole slide is then dipped endways into a bottle of turpentine, by which the paraffin is all dissolved off at once, if properly softened. The slide is then mounted direct in balsam, by dropping on some balsam diluted with turpentine, and applying either a single cover glass of the whole length, or two or more square cover glasses to make up the required length. The sections remain quite fixed on the slide in the positions they were originally placed upon the collodion film, and there is no danger of any displacement or injury in the subsequent processes of the mounting.

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THE PRE-CARBONIFEROUS FLOOR OF THE MIDLANDS.

BY W. JEROME HARRISON, F.G.S.

(*Continued from page 167.*)

The Bunter Conglomerate.—This great accumulation of more or less rounded blocks of rock can be traced across the North Midlands from Worcester, by Bridgnorth, Stourbridge, Cannock Chase, Sutton Park, and Lichfield, to near Ashbourn and Derby. In a north-easterly direction it becomes a pebbly sandstone at Nottingham and in Sherwood Forest; but further north, near Selby, the pebbles disappear altogether, and in the borings through the Trias at Scarle, and near Middlesbro', none were met with. The same change takes place in the west, for the pebbles in the Bunter round Liverpool are small and few, while in the Carlisle district the lower Trias is not represented at all. In any case its only possible representative—the Kirklinton sandstone *—is quite devoid of pebbles.

The base of the Bunter Conglomerate is a breccia, sixty feet thick near Kidderminster, and well exposed at Bridgnorth and Kinver Edge. It consists of more or less angular fragments of grits, quartz, quartzite, sandstone, slate, and limestone. Above this we find from 100 to 300 feet of well-rounded pebbles, principally quartzites, although specimens of vein-quartz, chert, hard sandstones, mountain limestone, and traps and ashes, are present. Owing to the earth-movements in which the bed, as a whole, has taken part, the pebbles have been crushed against one another, so that they bear indentations which appear as white spots upon their surfaces. By the action of surface agents—principally ice during the last glacial period—immense numbers of the Bunter pebbles have been carried southward from the outcrop, and can be traced as far as the brow of the Thames valley.

The Trias has generally been regarded as an uninteresting set of rocks, owing to the almost total absence of fossils in its red marls and sandstones. This paucity of traces of life is usually assigned to the mode of its formation—deposited in a salt lake or lakes comparable with the Dead Sea or Lake Utah at the present day. But the pebbles of the Bunter contain numerous fossils, and if we are ever to know much of the source and mode of formation of this very remarkable and interesting conglomerate it must be by a close study of

* See T. V. Holmes, Q.J.G.S., Vol. XXXVII., p. 286.

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these fossils, aided by a careful examination of the rock fragments which contain and accompany them. Such a study has only recently been possible, so that but scanty results have as yet been obtained.

Fossils in Bunter Pebbles.—The lowest horizon to which any of the fossils as yet discovered in the Bunter belong is (according to Mr. Thos. Davidson, to whom I am much indebted for his identification of the species) the equivalent of the Arenig Beds, which form the quartzite of the Stiper Stones west of the Longmynd, and are present in Brittany as a very similar rock—the *Gres Armoricain*. This Lower Silurian formation has yielded numerous pebbles of quartzite and indurated sandstone to the Midland Bunter, which can be identified by the presence of the fine brachiopod *Lingula Lesueuri*,* and such lamellibranchs as *Modiolopsis**, *Palæarca* (which is found *in situ* in the Arenigs near Norbury), and *Lyrodesma*.

Next in order of time we find representatives of the Caradoc and Bala Beds, including *Orthis Budleighensis*,* which occurs more frequently than any other species; *O. Valpyana*, *O. elegantula*, *O. unguis*, *O. biforata*, *O. calligramma*,* and *Leptæna sericea*. Shells of the genera *Pterinea*,* *Ctenodonta*, and *Cleidophorus* may also be referred to this period, and remains of a crinoid—probably *Glyptocrinus basalis*.*

From the Upper Llandovery Beds we get sandstone pebbles (identical in character with the rock which fringes the eastern side of the Lickey) containing internal casts of *Stricklandinia lirata*,* and the coral *Petraia bina*.*

Although no Devonian strata crop out in the Midlands, yet we find quartzose sandstones of this age—proved to be Devonian by the fossils they contain—in the Bunter.

The commonest Devonian fossil is *Spirifera Verneuilii*, with which we get *Rhynchonella daleidensis*, *R. Valpyana*, *R. elliptica*,* *R. Thebaulti*, *Orthis laticosta*, *O. Monnieri*, *Strophomena Edgelliana*, and *Streptorhynchus crenistria*.* Worm-burrows, belonging to *Trachyderma serrata*,* &c., are very common in the quartzite pebbles, but I have never found any other fossil in the same pebble. Fragmentary remains of other fossils, as a *Theca*, the trilobites *Phacops** and *Homalonotus*, and fucoids, are not rare, but they are usually too imperfect for specific determination.

Of the above fossils I have found those marked with an asterisk both in the drift-gravels round Birmingham and in the Bunter Beds of Sutton Park. That the entire suite is to be found in the Bunter I have no doubt, but I have not had a good opportunity of collecting from that deposit, while the quartzite pebbles of the gravels are largely excavated and

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broken up for road-mending near my house. Several of the species named above have also been collected by Prof. Bonney from the Bunter of Cannock Chase, by the Rev. P. B. Brodie from the Drift at Rowington, by Messrs. Jennings and Shipman from the Bunter of Nottingham, by Mr. A. H. Atkins from the pebble-beds of Kinver Edge, and by Mr. F. T. S. Houghton from the Drift near Moseley. Many years ago Mr. S. G. Perceval collected diligently from the drift at Harborne and at Moseley, suburbs of Birmingham.

Mr. W. Molyneux has obtained from the Bunter of Cannock twenty species of fossils belonging to the May Hill Sandstone, and twenty-two species in pebbles of Mountain Limestone. A more exhaustive examination of the Bunter pebble-beds along their course from west to east is much to be desired, and is a work well worthy of the best energies of those who live near places where this formation is well exposed. The conditions of search will be most favourable in pits where the pebbles are broken up for road-metal, and the services of the workmen should be enlisted in the search. Not only should the fossiliferous pebbles be collected, but as complete a set as possible of the rock-varieties represented should be secured.

The Keuper Pebble Bed.—In the Midlands, there is an unconformity between the Bunter and the Keuper, and the latter formation is ushered in—locally—by a breccia which resembles that found at the base of the Bunter. It contains numerous angular quartzite pebbles, and its extreme thickness is forty feet. In the Alton and Peckforton Hills this Keuper breccia is repeated by strike-faults, and so forms two or three ridges parallel to one another. No thorough examination of the pebbles has yet been made, a task which local geologists might well undertake.

The Pebble Bed of Budleigh Salterton.—In looking elsewhere for an analogy to the Bunter Conglomerate of the Midlands our attention is at once arrested by the remarkable accumulation of quartzite pebbles which form a bed eighty feet thick in the Triassic cliffs at Budleigh Salterton, near Exmouth, in Devonshire. In a beautiful monograph on the fossil brachiopods obtained from this locality, Mr. Davidson has described * twelve species from the Arenigs; eight from the Caradoc; and thirty-three from the Lower Devonian formation; about thirty other species of fossils belonging to these formations have been found at Budleigh, by Messrs. Wyatt-Edgell, W. Linford, W. Vicary, and others.

* Volume of the Palæontographical Society for 1881.

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It will be seen that in lithological character and palæontological contents the resemblance to the Midland Bunter is very close. Of the nineteen species of brachiopods found near Birmingham, eight are known from Budleigh Salterton; and the accompanying fossils are also very similar. From general considerations the Devonshire geologists have been led to assign the rocks from which the Budleigh pebbles were derived to a position somewhere in the English Channel, but it seems to me quite possible that they may have come from the north-east; the ancient Midland land barrier—isthmus like—yielding a supply of rock-fragments (though not necessarily contemporaneously), both to the north and to the south.

At a later period—early in Tertiary times—the Oldhaven Beds of Kent and Surrey show a mass of flint pebbles (derived from the chalk) with which, in a sandy matrix, are many contemporaneous marine fossils.

At the present day the famous Chesil Beach of Dorset, the Cahore Beach near Wexford, and the similar beaches which fringe Lake Superior afford instances of vast accumulations of well-rolled pebbles produced by the action of currents and tides, aided by the configuration of the land.

Underground Extension of the Pre-Carboniferous Rocks.—It goes without saying that the isolated outcrops of Laurentian, Cambrian, and Silurian rocks, which we have described as occurring between Charnwood and the Malverns, must be connected underground by a continuation of the strata. Of the presence and position of these pre-carboniferous rocks we have had evidence afforded by several borings. In the first place it seems pretty clear that these three great geological formations were once continuous over the Midland area, and that where the Cambrians are absent, and we come upon Silurian, or where both Cambrian and Silurian strata are wanting, and the borehole enters the Archæans, it is because one or both of the newer formations has been removed by denudation in post-Silurian times. Secondly, there is an absence of rocks of the type of the Old Red Sandstone. Strata belonging to the coeval Devonians have, however, been reached in the borings at Turnford, and in London, and it is probable that these include a band of quartzite, from which the fossiliferous pebbles that occur in the Midland Bunter, with such Devonian species as *Spirifera Verneuilii*, have been derived. Thus the first appearance of the Midland Axis, or land barrier, was probably during Devonian times, and this land had its southern margin somewhere along the Charnwood-Malvern line.

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During the Carboniferous era the existence of land in Mid-England is demonstrated by the absence of the mountain limestone and millstone grit. The northern margin of the axis probably consisted of Silurian shales.

In Permian and Triassic times bolder cliffs and hills furnished the breccias and pebble-beds of the Permian and Bunter; while the continued existence of the ridge during the Jurassic epoch is shown by the manner in which the Liassic and Oolitic strata thin as they approach it, and by the pebbles contained in the Lower Greensand, &c. Finally, the old land disappeared beneath the waters of the cretaceous ocean.

Keeping these facts in mind we can apply them to discover the probable nature of the rocks to be found beneath the Mesozoic strata of the Midlands. Borings through these Mesozoic rocks are likely to be undertaken for two objects only:—

(*a*) In search of Water.

(*b*) In search of Coal.

The Bunter sands and pebble-beds form the main source of underground water supply of the Midlands, and the towns of Leicester, Northampton, &c., have hoped to derive from them a supply comparable with that obtained at Birmingham, Stourbridge, &c. But as we go south and south-east we approach the ancient land barrier, and the Lower Trias thins away and disappears; so that the Bunter is all but absent in Leicestershire, and entirely absent in Northamptonshire.

As respects the probable occurrence of seams of coal, a similar change must be taken into account. The present southern boundary of the coal fields of Warwickshire, Leicestershire, and Staffordshire nearly represents the ancient termination of the swamps on which the coal plants grew; and the region between the Hartshill-Malvern line on the north, and the Thames Valley on the south, includes an area in which buried coal fields are not likely to be found.

THE BITTERN IN SUTTON PARK.—It is perhaps scarcely necessary to warn the naturalists of the Midlands against believing in the occurrence of the Bittern in Sutton Park without further evidence than that afforded by Mr. Bath (p. 107). Mr. Bath will now, I think, allow that his statements were founded upon a regrettable mistake. The so-called Black Tern (p. 108) also may have been another bird, and the mistake in the identification of the animal called a Pine Marten (p. 109) is so obvious as to need only to be pointed out.—W. B. GROVE, B.A.

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THE EAR AND HEARING.

BY W. J. ABEL, B.A., F.R.M.S.

(Continued from 169,)

The walls of the tympanic cavity are bony, lined with mucous membrane, and ciliated. The inner wall contains two orifices leading into the internal ear, and closed by a membrane somewhat similar to the tympanic. The larger of these openings (the *fenestra ovalis*) is oval, the smaller (the *fenestra rotunda*) is round. We may, perhaps, explain the use of these openings by noting that in passing from air to water directly, sonorous vibrations are greatly weakened, but that the interposition of a tense membrane between the two media greatly intensifies the vibrations. Crossing the tympanum is a chain of very small bones—the *Malleus* is attached by its slender end, or handle, to the tympanic membrane,—the *Incus*—a bicuspid tooth-shaped bone, rests by its body on the head of the malleus, whilst the longer of its two fang-like processes is articulated by a round tubercle, by some called the *orbicular bone*, with the *Stapes* which covers with its base the fenestra ovalis. These beautiful little bones have synovial membranes and capsular ligaments at their articulations, as in the case of the other perfect joints of the body, and are covered by mucous membrane reflected from the tympanic walls. Any vibration which, passing up the outer canal, affects the tympanic membrane, is conveyed with great intensity through these bones to the fenestra ovalis, the membrane of which is thus strongly agitated. The movements of the tympanic membrane cause the long processes of the malleus and incus to swing like a pendulum upon the axis furnished by the short processes of these two bones.

Two distinct theories are offered as to the route which the sonorous vibrations follow—1. That they pass through the ossicles merely, causing both molar and molecular vibration; and 2, That the air in the drum is set vibrating by the outer membrane. The considerations guiding our preference are (*a*) the drum is not a perfectly closed chamber, and any vibrations excited in its contained air would be liable to escape by the eustachian tube; (*b*) its internal surface is constantly moist, but moisture tends to deaden vibration; (*c*) the bones form a complete link across the drum, and it is well known that solids conduct vibrations more rapidly and forcibly than fluids; (*d*) they are covered with a

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moist membrane which, by being a bad conductor of vibrations, tends to prevent the vibrations passing through them being weakened by diffusion, and (*e*) in the internal ear there are *six* separate canals, with five of which the fenestra ovalis communicates, and, being covered by the stapes, air vibrations would be obstructed in their passage to the labyrinth through it, whilst the fenestra rotunda, which is exposed, communicates only with one of the internal canals. Hence the vibrations would seem to be transmitted through the bones, partly by their molecular, but chiefly by their absolute movement. The theory of mixed transmission through the co-operation of air and bones seems untenable, inasmuch as vibrations travel through them with different velocities. Edouard Weber thought the fenestra rotunda, by means of its elastic covering, acts as an adjunct to the fenestra ovalis, facilitating the approximation and removal of the stapes from the labyrinth, by its alternate compensating movements towards and from the tympanic cavity.

The *Labyrinth* (the essential part of the organ of hearing) consists of a small bony chamber, called the vestibule, three semicircular canals (two vertical and one horizontal), and a structure called, from its resemblance to a small shell, the cochlea, all hollowed out of the hardest (petrous) part of the temporal bone.

The *Vestibule* is a small irregular chamber about the size of a grain of barley. Leading from it are the five openings of the three semicircular canals (three in the posterior and lower, and two in the superior horn)—several openings in its inner wall for the entrance of the auditory nerve filaments, —the fenestra ovalis in its outer wall,—the opening leading to the cochlea in its inferior and anterior wall—and in its posterior wall an opening called the *aqueductus vestibuli*, with uncertain contents and office. The vestibule contains two distinct membranous bags—the larger, oval in shape, called the *common utricle*, from which spring the three membranous canals lining the bony semicircular canals; the smaller bag somewhat globular (hence called the *sacculus hemisphericus*).—It communicates with the middle chamber of the cochlea (the Scala Media). The membranous labyrinth contains a watery fluid called endolymph, whilst it is separated from the bony labyrinth by a similar fluid called the perilymph. These fluids contain small particles, composed of carbonate and phosphate of lime, to which their discoverer, Breschet, gave the name of otoconia (ear-dust). Branches of the auditory nerve enter the utricle and semicircular canals and are thus affected by any vibrations which occur in the contained fluids,

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the effect being intensified by the bombardment of the otoconia, found chiefly in the vestibule, and by the peculiar arrangement found at the orifices of the semicircular canals, which have a diameter of about $\frac{1}{20}$ inch. Where these join the vestibule they dilate into three ampullæ. On the inner walls of these ampullæ are found a number of minute hair-like filaments, which, being connected at their bases with auditory nerve filaments, are very sensitive to impressions of sonorous undulations. The function of the semicircular canals has been thought to be the collection in their fluid contents of the sonorous undulations communicated through the cranial bones, and the magnification of the vibrations excited, in the ampullæ and utriculus, in which they are assisted by the crystalline pulverulent ear stones, which, as above noted, tend to reinforce sonorous vibrations both by their resonance and by their bombardment of the epithelial cells of the vestibule.

The *Cochlea* is situated in front of the vestibule on the inner side of the internal meatus of the ear. It is a very complicated structure, somewhat resembling a snail shell, having two turns and a half in its spiral. We may, perhaps, best represent it by a tube about half an inch long, having a diameter of one-tenth of an inch at its base and one-twentieth of an inch at its termination, divided longitudinally into three unequal compartments, and coiled two and a-half times round a central conical pillar (the *modiolus*). The base of the modiolus is pierced by canals for branches of the auditory nerve (entering through the internal meatus), and blood-vessels. The largest of these canals is called the central canal of the modiolus. The middle and smallest of the chambers of the cochlea is called the Scala Media (or *canalis cochlearis*). It is a continuation of the membranous labyrinth, and completes the division between the other two chambers. It is closed towards the top of the cochlea and opens below by a small neck into the Sacculus of the vestibule. The other two chambers are named from their connections. The Scala Vestibuli opens into the bony vestibule, and is thus open only to the action of the perilymph; the Scala Tympani communicates with the tympanum and the fenestra rotunda. At the top of the cochlea the scalæ tympani and vestibuli communicate by a small aperture called the Helicotrema, left between the top of the modiolus and the Hamulus, or small hooked termination of the Lamina Spiralis which is the partition, partly bony and partly membranous, separating the two larger scalæ.

(To be continued.)

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THE PRINCIPLES OF BIOLOGY.

BY HERBERT SPENCER.

EXPOSITION OF CHAPTER XI.—ON "CLASSIFICATION."

[ABSTRACT.]

BY PROF. W. HILLHOUSE, M.A., F.L.S.

Classification has a two-fold purpose; to render identification more easy, and to organise knowledge. When a librarian arranges his books according to their authors' names he renders the identification, *i.e.*, the discovery of any particular one, easy, and he renders it easy likewise to insert in its proper position any work subsequently written. But this arrangement has one systematic weakness; the practical impossibility of finding a work of which you know everything excepting the smallest part—its author's name. Or the books may be arranged according to subject, in which case grouping and sub-grouping to several degrees will, in a large library, have to be resorted to. Further, this involves some knowledge of the contents of the books, and, to be philosophical, a conception, to some degree definite, of not merely the present but the proximate, not to say ultimate, extent of knowledge. This latter method would of necessity come late in the history of books.

Each of these methods is, but in varying degree, a classification by the attributes or properties of the books; in the former case but one attribute, the author's name, is used. Any other single attribute could equally be used, knowledge of the attribute being then alone required for identification; the books can then be placed in definite order or series. In the other case several attributes may be in use, and variously in use, for each volume; here, therefore, true linear arrangement becomes impossible, for there is no reason, other than empyrical, for giving priority to any group of books or to any book in a group; all that you can do is to constitute groups, of which you can indicate the relationship. The growth of such a method must be slow.

Other things being equal, the relations amongst phenomena are recognisable in the order of their conspicuousness and simplicity. *Cæteris paribus*, a child will more readily first recognise the male by a beard. Then all bearded males become "papas." With advancing perceptive powers differentiation comes into play, and with it a tendency to more

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accurate grouping. In the history of the knowledge-relations of a race, the same principles are involved, and classificatory notions would go through a cycle of phases, at first exceedingly simple, gradually increasing in complexity and accuracy of differentiation; individual qualities or attributes would be replaced by groups of qualities or attributes; objects possessing some of one and some of another group would have their attributes analysed, and comparative values would thus be given to each individual quality. The ultimate classification would therefore imply not merely knowledge of many attributes of the object in question, but the relative importance of these in some, at first no doubt empyrical, scale, and the mere position given to an object would give us the largest possible amount of information about it and its attributes.

An illustration of the growth of the classificatory idea is afforded by the common dictionary or encyclopædia. Itself the proof of great advance, in it, nevertheless, but one property, and that artificial in the extreme, viz., the order of the letters, is the key to the whole system, and "Baby," with its appendages, is found next door to "Babylon," "Dog" to "Dogma," "Hosier" to "Hospice" and "Hospital." A step in advance is shown by a recently published Anglo-French Dictionary, where all the words of common root origin are kept together, and apart from all the words of other root origin. The highest stage of verbal classification is shown, perhaps, by such a work as the "Thesaurus of English Words and Phrases" of Dr. Roget, in which the words are systematically arranged according to their actual value and relations, whether abstract, or in space, matter, &c., and quite independently of root origin. But the inapplicability of such classifications to finite beings, in a subject in such general use as language, is shown by the provision of an alphabetical glossary as a key to the whole. Such highly developed forms of classification emanate from, and appeal only to, the specialist.

Natural objects of course come upon a different footing to words; but here, too, probably the most perfect classification for specialists will be that which, based as far as may be on, to borrow our above phrase, *common root origin*, is leavened with a full share of present *physiological and morphological meaning*.

These phases of classification are well illustrated by the biological sciences. The use of simple and conspicuous characters led to the classification of plants into trees, shrubs, and herbs, an arrangement still popularly clung to. Cæsalpinus (1583) slightly amplified this into trees, undershrubs,

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and herbs, and flower and seedless plants. So in the world of animals, the beasts, birds, fishes, and creeping things of the Mosaic philosophy, groups which differ from one another in conspicuous features of appearance and mode of life, these are the first formed divisions, and to this day the vast proportion of humanity to whom it is known would regard the whale as a fish because its habit of life appears to resemble that of fishes.

Coming to distinct attempts at classification, we find the "one attribute" principle, or, at the most, simple departures therefrom, first in use. This is peculiarly the case with the vegetable kingdom. The corolla, the fruit, the calyx and corolla, and the stamens and pistil have provided by their modifications the principles for classification. The last of these, in the well-known Linnæan system, is still in wide popular use. But of these early attempts at classification many of the secondary groupings are much more philosophical, as for example is that of Ray. In classification, the old battle of the Aristotelian *versus* the Baconian philosophy has had to be fought out. The earlier systems were all Aristotelian in principle; some are more or less so still, while the ultimate classification must be on Baconian lines; the units must be studied before the groups, the groups before the classes. *Accurate classification works upwards.* For long the ultimate form of vegetable classification given by Spencer has been superseded, and for the last score of years or more English botanists at any rate have abandoned attempts to make systems, and have devoted their attention to the practical application of the law italicised above, by the study of the units of the vegetable kingdom, and attempting then to define the limits of genera.

In all modern systems of classification, the linear arrangement has disappeared, and instead of it appear groups and sub-groups whose relations with one another are very various, and dependent on internal as well as external organisation, on organs as well as on members. And the marked tendency of modern classifications is to base the widest groupings on points of physiological, the narrower of morphological importance. Internal organisation is of higher classificatory importance than external form. The newest tendency throws things still further back. Believing that the early history of an individual shadows the past history of its race, the modern systematist becomes more and more embryological, and here the Baconian philosophy must of needs have fullest play. One thing is clear. Linear arrangements are things of the past.

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METEOROLOGICAL NOTES.—May, 1885.

Atmospheric pressure was unsteady throughout the month, though the range was not large. The barometer attained its highest point, 30·207 inches, on the 12th. The past month was remarkable for its low mean temperature—above 4 degrees lower than the average. The minimum was below 40 degrees on sixteen nights, as against ten in 1883 and 1884; while the maximum reached 60 degrees on only seven days, as compared with seventeen in 1883 and nineteen in 1884. The highest readings were registered on the 28th, and were 71·2° at Loughborough, 70·8° at Hodsock, 69·9° at Strelley, 68·5° at Coston Rectory, and 68° at Henley-in-Arden. In the rays of the sun, 130·1° at Loughborough, 126·2° at Hodsock, and 125·6° at Strelley, also on the 28th. The lowest readings were 27·9° at Hodsock, 28·5° at Coston Rectory, and 29° at Henley-in-Arden, on the 12th; 30° at Strelley, on the 7th and 8th; and 30·9° at Loughborough, on the 7th. On the grass, 19·4° at Hodsock, on the 7th; 24·2° at Strelley, on the 8th; and 25° at Loughborough, on the 12th. Rainfall generally was below the average, excepting at Henley-in-Arden, where the observer reports it to have been 1·16 inches in excess of the mean of fifteen years. The amount at that station was 3·59 inches; at Strelley, 1·97 inches; Loughborough, 1·87 inches; Coston Rectory, 1·83 inches; Hodsock, 1·73 inches. The number of "rainy days" varied from twenty to twenty-one: the heaviest falls from 0·64 to 0·30. Snow fell at Henley-in-Arden on the 5th and 7th. Lightning and thunder were observed at Loughborough on the 17th and 21st. Sunshine was deficient.

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Reviews.

Ordnance Atlas of the British Isles, with Plans of Towns. Price 35/- Published by G. W. Bacon, 127, Strand, London.

This magnificent atlas is, beyond all question, the best of its kind with which we are acquainted. It includes index maps of England, Wales, Scotland, and Ireland; forty-nine maps of the English counties (double maps being devoted to the large counties); large-scale maps of Wales, Scotland, and Ireland—each in four sections; an excellent (double) geological map of England; twenty-three large-scale plans of towns; eight maps of environs of towns; and, finally, five maps of the Isle of Man, Isle of Wight, Channel Isles, Orkneys and Shetlands, and the Lakes of Killarney. The extensive alphabetical indices contain more than 50,000 names; the introduction includes fifty-four pages of valuable letterpress.

The great merit of the work, of course, lies in its being an accurate reproduction of the Ordnance Survey. The large scale of the maps—which are about 16in. by 12in.—permits of every detail being shown, and for clearness of roads and railways this atlas is unsurpassed. The plans of the towns are from the Government Surveys, which have only just been completed; and the idea of issuing maps of the environs of the large towns, showing the country for twenty or thirty miles round, is a very happy one. All the maps are beautifully printed in colours on thin tough paper on guards, while the binding is excellent. Altogether this is a book which we can strongly recommend.

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Photo-micrography. By A. C. Malley, B.A., F.R.M.S. Second edition. Sm. 8vo., 166 pp., 3 plates, 28 woodcuts. Price 7/6. Published by H. K. Lewis, Gower Street, London.

This very useful book is the only one published—in England at all events—upon the subject, and the fact that it has so soon reached a second edition proves its usefulness. It includes a description of the apparatus required, suitable methods of mounting, the wet collodion and gelatine dry-plate processes, with an account—well illustrated—of the arrangement of the apparatus for photo-micrography, and a dissertation on the faults most commonly met with, and their remedies. The plates include photo-micrographs of various diatoms—enlarged from 1,000 to 1,500 diameters—physiological slides, butterfly scales, &c. Altogether the book is a suggestive and a useful one, and we commend it to the rapidly increasing class of our readers who have taken up the study of photography.

Leafing of Oak and Ash.—During the month of May last the foliation of many hundreds of these trees was observed in Bedfordshire and Hertfordshire. It was not till the third week that the oak trees were well expanded, and the ashes as a whole were several days later. Some of the latter were not in full leaf till quite the end of the month. There were a few instances, possibly five per cent., in which the ash trees, in similar circumstances with oak trees, were equally advanced with them. These were, probably, especially vigorous trees. This is now the sixth consecutive season in which the leafing of these trees has been relatively the same. J. Saunders.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Geological Section, May 26th.—Mr. Beale, of Rowley Regis, exhibited various specimens from calciferous sandstone, carboniferous limestone, Yoredale rock, coal measures (lower) not local; coal measures, local. Plants: mollusca, crustaceans, and icthyolites of unknown or little-known species. Also, spotted coal. Mr. A. H. Atkins, Silurian specimens from Purlieu Lane, Malvern, which in the space of less than a mile shows sections of all the Upper Silurian Beds. Fossils: *Pentamerus oblongus*, *Stricklandinia lirata*, *Orthis lunata*, *Rhynchonella nucula*, *Lingula Lewisii*, *Avicula Danbergii*, and *Phacops caudatus*.—June 2nd.—Mr. T. Bolton exhibited young lampreys just hatched from the eggs; also *Notommata brachionus* from King's Norton. Mr. W. B. Grove, B.A., then read an interesting paper on "A Botanical Tour on a Laburnum Leaf," which he illustrated by coloured diagrams and mounted sections under the microscopes. He also exhibited the microscopic plants themselves, viz.: *Leptosphæria Lucina* (new to Great Britain); also *Glœosporium cytisi*, *Phyllosticta cytisi*, *Alternaria brassicæ*, *Cladosporium fasciculare*, *Epicoccum neglectum*, and *Fusarium roseum*, all on laburnum leaves from Bradnock's Marsh, Hampton-in-Arden. The paper also offered evidence in favour of the modern tendency to found the species of parasitic Fungi on a narrow biological basis, even where no difference of form existed.—Biological Section, June 9th.—Mr. Charles Pumphrey exhibited a beautiful selection of Swiss alpine plants, cultivated in his garden from roots gathered in Switzerland; Mr. T. Bolton, F.R.M.S., a gelatinous ring of green ova, probably of a water beetle, and *Leptodora hyalina*; Mr. W. B. Grove, B.A., Fungi, *Agaricus sphagnorum*, *A. electicus* (rare),

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Peziza Curreiana, from Sutton Park; Mr. J. E. Bagnall, A.L.S., *Medicago maculata*, *M. denticulata*, *Pyrus Aria* (all rare), and a moss, *Fontinalis antipyretica* (in fruit), first time observed in fruit in Warwickshire, all from Weddington; and for Rev. D. C. O. Adams, The Morrell, *Morchella semilibera*, from near Coventry, with microscopical preparations to show asci and spores.—At the Sociological Section's meeting on the 4th instant, Miss Naden read chapter vi. of Mr. Herbert Spencer's "Study of Sociology" on "Subjective difficulties—Intellectual," followed by discussion and elucidations joined in by Mr. W. R. Hughes, F.L.S. (Chairman of the Section), Dr. Carter, Mr. C. H. Allison, and others.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—June 1st. Mr. Beale exhibited some of the rarer fossils of the Wenlock limestone of Dudley, including specimens of *Eichwahldia capewelli*, *Avicula mira*, *Cyrtia*, &c. Mr. Deakin, a collection of fossils from Cheltenham. Mr. Madison, the black slug, *Arion ater*, var. *abalateralis*. Under the microscope, Mr. Tylar showed a palate of *Trochus zizyphinus* stained in two colours.—June 8th. Mr. Rodgers showed a collection of minerals from the Rowley Regis quarries. Mr. Delicate, a photograph of a fault in the quartzite at Rubery. Mr. Madison, specimens of *Helix revelata* from Jersey, and some large specimens of *Ancylus fluviatilis* from Yardley Wood. Mr. J. Betteridge, a collection of birds' nests and eggs, including two of the chaffinch; the eggs in one were of the normal colour, while in the other they were pale blue without spots. A nest of the dormouse was also shown.—June 15th. Mr. Madison exhibited a case of *Helix aspersa*, showing numerous variations in colour and size. Mr. Hawkes, *Æcidium tragopogonis* and *Ustilago receptaculorum*, both on the goat's beard. Mr. Tylar, an early work on the microscope, by Henry Baker, quaintly illustrated, and dated 1769. Under the microscopes, Mr. Moore showed jaws of helices; Mr. J. W. Neville, wing of butterfly, *Morpho cypris*. A paper was then read by Mr. H. Insley on "The extraction and mounting of molluscan palates," which described the anatomy of the garden snail, whelk, &c., the best means of extracting the palates, and the most suitable media for mounting, glycerine being generally preferable for those not requiring polarised light. The process of dissection was shown.

CARADOC FIELD CLUB.—The first excursion of the season was made to the Titterstone Clee Hill, near Ludlow, on the 19th ult. The party assembled at Ludlow and proceeded by carriages through some of the most beautiful scenery of South Shropshire to the village of Bitterley, situated at the foot of the hill to be ascended. Here the church, with its fine Norman font, its ancient oak chest, its carved oak pulpit of Jacobean date, and its many interesting monuments, was inspected, under the guidance of the venerable Rector, assisted by Sir Charles Rouse Boughton, Bart. In the churchyard stands a remarkably fine cross, attributed by some authorities to the year 1500, by others to the time of Richard III. The party was then invited to inspect the garden and house of the Rector, who exhibited a most interesting collection of ancient deeds, books, pictures, &c., the accumulation of many centuries by the members of this ancient Shropshire family. After partaking of the hospitality of their kind host, the party proceeded to the proper work of the day, viz., to investigate the natural features and productions of the hill, which rises boldly to the height of 1,754 feet, the summit being crowned by an ancient encampment,

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whence may be seen a magnificent panorama embracing parts of Herefordshire, Radnorshire, Montgomeryshire, and Worcestershire. At this point the President, the Rev. J. D. La Touche, delivered an able address on the geology of the hill, which we hope to give *in extenso*, illustrating its formation by that of Graham's Island in the Mediterranean, which was thrown up by volcanic agency in modern times. After inspecting the exposure of columnar basaltic rock, visiting one of the coal pits, and collecting abundant fossils, the party returned to Ludlow, highly satisfied with the day's excursion.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY.—SECTION D.—ZOOLOGY AND BOTANY.—Chairman, F. T. Mott, F.R.G.S. MONTHLY MEETING, Wednesday, June 17th. The Chairman reported that on the field day on the previous Wednesday ten members went to Broughton Station, walked four miles by Cosby, and returned from Countesthorpe Station. A few of the less common plants were found, but nothing remarkable. Search was made, but in vain, for the true *Cerastium semidecandrum*. The chairman also reported that he had been invited to visit the Osier Grounds belonging to Messrs. Ellmore and Son, the well-known Leicester basket manufacturers, in order to give an opinion as to the cause of a serious blight which had destroyed £400 of young trees. He found about sixty acres planted with willow stools, of about forty different varieties—a most interesting and remarkable collection. Many had been imported from various countries, and each was considered to have its own particular value for certain kinds of work. The blight appeared to have been caused by myriads of black aphides, which covered the young shoots last summer, leaving a black stain on the bark of the withered and exhausted twigs. The stools being mostly only two years old, were unable to bear the drain of sap extracted by the aphides, and either died during the autumn or failed to put out fresh shoots after the rods were cut in the winter. He had advised the proprietors to employ a man at once to go through the whole nursery with a basket, cutting off every twig on which an aphis could be found, before they should have time to multiply again to any formidable extent. The following objects were exhibited:—By Miss Adderly, a living specimen of *Sedum rhodiola*, in flower, from the Isle of Skye; by Mr. E. F. Cooper, F.L.S., a living specimen, in flower, of *Orchis ustulata*, from Beachy Head, and a fine truss of the very elegant flowers of *Kalmia latifolia*, showing the curious manner in which the elastic stamens are held back until ripe in pockets of the corolla; by Dr. Cooper, a specimen of *Hippocrepis comosa*, from Eastbourne; by the chairman, a mass of algæ from one of the waterworks reservoirs, which Mr. F. Bates stated, after examination, consisted chiefly of *Spirogyra longata*, *Weberia tenuissima*, and *Calospora*, with various desmids, diatoms, and bacteria. Miss Iöns, of Craven House, Princes Road, was elected a member of the section.—The Chairman read a paper on "The Campanulas of Leicestershire," illustrated by dried specimens of all the British campanulas, and drawings of the reproductive organs of *C. glomerata*, showing the peculiar manner in which the anthers deposit their pollen on the hairy style. He also reported that the Council of the Society had passed a resolution inviting the sections to send in papers for publication in the Society's transactions *in extenso*, instead of in brief abstract as before. This was an important change, and would place the Society on a footing which it had never hitherto held, as one of those which publish "Transactions" in the technical sense.

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THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

PART I.

(Continued from page 188.)

SOME SECTIONS ILLUSTRATING THE DEVELOPMENT OF THE "MARGARITATUS" ZONE IN NORTHAMPTONSHIRE.

The number of sections in which the "Margaritatus" Zone can be studied is not large, but the beds of which the zone is made up are as interesting, palæontologically, as any in the Middle Lias. The section given below cannot now be seen; it was worked a short time for stone, and then covered up again. The situation is on the side of a steep hill overlooking Banbury, about a mile or more from Chalcomb, and quite away from any road.

SECTION NEAR TO GIBBARD'S FARM, CHALCOMB.

		Feet.	In.
	1.—Soil and light-coloured clay	3	0
"Margaritatus" Zone.	K. 2.—Sandy clay or shale, light brown colour, micaceous and ferruginous, joints red ...	2	3
	K. 3.—Band of ironstone concretions, with some small pebbles, containing:—*Modiola, Astarte striato-sulcata, Arcomya hispida, Pecten æquivalvis, Avicula inæquivalvis, Small ammonites (probably A. margaritatus)*	0	9
	K. 4.—Sandy clay or shale, light brown colour, highly micaceous, joints and surfaces reddish. No effervescence with acids:—*Ammonites margaritatus (small specimens), Avicula inæquivalvis, Pecten æquivalvis, Pecten liasinus, Modiola, Protocardium truncatum*, &c.	2	7
	L. 5.—Hard calcareous rock, mottled in places, and containing much crystallised carbonate of lime. Highly fossiliferous, but the fossils difficult to extract or identify in the stone:—*Ammonites sp? Ostrea, Limea acuticosta*		
	Good spring of water.		

The hard bed, No. 5 ("L" of typical section), contained some very pretty pieces of stone, pieces full of little cavities partially filled with crystallised carbonate of lime (congealed

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water as the people there told us), the remainder of the stone being a bright orange or red colour. Our attention was directed to this quarry by noticing the pieces of variegated stone preserved as ornaments at the village inn. It was not possible to measure the bed No. 5, but I should scarcely think it is more than two feet in thickness, because a good spring issues from the side of the hill very little below the level of the exposed part of the bed. There are several good springs around at about the same level, and evidently coming from the same bed.

I know of no other sections in the neighbourhood of Chalcomb in which the beds described above can be now seen, but they have been exposed at Middleton Cheney, and the lower one was worked for road metal some years ago at Warkworth and Overthorpe.

The beds 2, 3, and 4 I have classed together as "K;" the band of ironstone nodules has been found nowhere else.

All the Middle Lias sections I have been able to discover between Chalcomb and Byfield exposed the "Spinatus" Zone only, and so for the present I pass them by. At Byfield, however, there is a very complete development of the Middle Lias beds we are considering. On the East and West Junction Railway, extending from near Aston-le-Wall to Byfield, are several sections of the Middle and Upper Lias. The whole of the beds from the "*Communis*" *Zone* of the Upper Lias to the base of the "*Margaritatus*" *Zone* of the Middle Lias have been exposed, though only the hard beds above "I" can now be seen. The complete section will appear later on, but I may say that the bottom hard bed "L" was found, and that there are some springs in the neighbourhood much below the level of the rock-bed, which in all probability issue from the base of this bed "L."

Along the valley between Hellidon and Catesby there are some exposures of the lower beds of the Middle Lias by the side of the brook. In the part of the valley near to Hellidon, where a little fall of water occurs, the side of the brook is composed of a blue micaceous clay containing a few fossils (only *Limea acuticosta* identified), and in the bank, some fifteen to twenty feet above, a very light brown rock may be seen, but no fossils could be detected on the occasion of my visit. A little further along the brook, and at about the same level as the micaceous clay above noticed, are some very large pieces of rock very much like the rock-bed of this neighbourhood. The former beds must be near the base of the "Margaritatus" Zone, and I expected to find that these large blocks of stone were the bottom bed, but

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there were no fossils to be seen, and moreover the stone could only be found at this one place. They are probably pieces of the rock-bed that have got there by accident. The bed "L" is apparently absent for a considerable distance along this valley, for a few months ago I found a heap of material that had been recently thrown out in deepening the brook for a sheep wash, and there was no trace of a hard bed.

There are two other sections, nearer DAY KNOWL, where a light grey clay is succeeded abruptly by a dark blue clay or shale, and these are commonly supposed to show the junction of the Middle and Lower Lias (Survey division).

Between Catesby and Staverton there are no sections to be seen in the valley, but the base of the beds I am here describing can be traced by the numerous springs which issue from the side of the escarpment. On the west of STAVERTON there is a rather steep lane, and at the bottom of it a good section, exposing the lower beds of the "Margaritatus" Zone.

SECTION AT STAVERTON.

	Feet.	In.
G. 1.—Soil and light-coloured sandy bed, not so micaceous or fossiliferous as the soft beds below. Not well exposed	3	0
H 2.—Soft, porous sandstone or limestone, very ferruginous, containing many fossils:—*Protocardium truncatum (abundant), Avicula inæquivalvis, Pleuromya costata, Pholadomya ambigua, Pentacrinite stems, &c.*...	2	9
I. 3.—Sandy micaceous clay, ferruginous in places, containing:—*Pecten liasinus, Limea acuticosta, Protocardium truncatum, &c.*	4	0
J. 4.—Calcareous and ferruginous sandstone, interior of bluish or slaty colour, containing:—*Protocardium truncatum, Limea acuticosta, Pleuromya costata, Pentacrinite stems, Fucoids (abundant)*	2	0
K. 5.—Sandy clay, light coloured, micaceous and ferruginous, containing a fair number of fossils, but these mostly casts	5	9
At this point a STRONG SPRING issues from the rock, and has cut deeply into the next bed.		
L. 6.—Hard fossiliferous limestone, ferruginous, in places made up of fossils, in others cellular, the cavities being lined with crystals of calc spar. Some parts of the face covered with deposited carbonate of lime, making it almost like a stalactite in appearance. Containing:—*Belemnites, Pecten æquivalvis, Pecten liasinus, Limea acuticosta, Protocardium truncatum, Astarte striato-sulcata, &c.*	1	4

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7.— Hard blue clay—depth unknown.

The section is probably twelve feet or more deeper, but so covered up that nothing more could be made out.

In a lane to the north of NEWNHAM one of the soft beds of the "*Margaritatus*" *Zone* may be seen. Judging by the condition of the bed, and the fossils found in it, I consider it to be either "I" or "K" of the typical section. It is light coloured, micaceous and ferruginous, and contains:— *Ammonites margaritatus*, *Pholadomya ambigua*, *Limea acuticosta*, *Pentacrintes*, and *Fucoids*, *&c.*

There is a small stone pit on the road leading from Daventry to Braunston, about a mile-and-a-half from Daventry, which presents some features I have not noticed elsewhere. Below is the section.

SECTION NEAR TO DAVENTRY.

	Feet.	In.
1.—Soil containing many pebbles from the drift ...	1	6
2.—Irregular sandy bed, containing many pieces of fossiliferous stone, fragmentary and waterworn. The fragments seem to contain fossils from at least three of the higher beds, but particularly from "F" and "H." Fossils: — *Ammonites spinatus*, *Terebratula punctata*, *Terebratula Walfordi (a single specimen of each)*, *Belemnites*, *Turbo*, *Avicula sp.? (very abundant)*, *Avicula inæquivalvis*, *Limea acuticosta*, *Pecten liasinus*, *Protocardium truncatum*, *Modiola*, *Ostrea cymbium*, *&c.* ...	1	6
3.—Hard compact rock, like that found at the base of the "Margaritatus" Zone at Chalcomb and Staverton. Very many fossils, but the stone so hard that few could be got out:—*Belemnites (very abundant)*, *Pecten æquivalvis (large)*, *Pecten liasinus (large)*, *Ostrea*, *Pleuromya*, *Protocardium truncatum*, *Limea acuticosta*, *&c.* *No Rhynchonellæ or Terebratulæ.* Thickness, one foot three inches...		
4.—Hardened, sandy, micaceous bed, could detect no fossils. Thickness, two feet six inches ...	3	9

Beds 3 and 4 in the above section can only be separated by a close examination; at a very slight distance away they appear like one block of stone only. I believe bed No. 3 is "I" of the typical section, but have never seen a bed like No. 4 underlying it elsewhere.

A little way out of DAVENTRY, on the Welton Road, two or three of the lower beds of the "*Margaritatus*" *Zone* may be seen. About a quarter-of-a-mile along this road the banks are very steep and rather high, and near the top is a

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moderately hard, shaly, highly micaceous bed, which is easily identified as "J" of the typical section; it contains: *Protocardium truncatum*, *Pleuromya costata*, *Limea acuticosta*, and *Fucoids (abundant.)* Below this is a reddish, micaceous, sandy bed, like bed "K," everywhere in the district. A little further from Daventry, just over the ridge of the hill, another hard bed is found in the bank; it is shaly, weathers rather white, contains very little mica, and much more resembles "F" than "H." No fossils were obtained, although parts of it seemed to be made up of comminuted shell. Apparently bed "H" ceases to exist as a distinct hard bed in this neighbourhood, for I have not found it in any section further north.

Several Middle Lias beds may be seen on the railway near to WATFORD LODGE, a description of which will appear later on.

I believe the junction of the Middle and Lower Lias may be seen in a brook near to ELKINGTON, but if so the bottom bed is absent. This is not surprising, because the whole of the Middle Lias is very much attenuated here, the rock-bed itself being very indifferently represented.

(To be continued.)

THE EAR AND HEARING.

BY W. J. ABEL, B.A., F.R.M.S.

(Continued from page 201.)

Upon the surface of the scala media lie several important structures.—1. On the side towards the tympanic scala is the very elastic Basilar Membrane upon which stand about 3,000 club-shaped fibres arranged in pairs forming arches. These fibres are called the Rods of Corti, and are thought to contain at least one nerve filament each.—2. Over these rods is the Membrane of Corti containing numerous cells of various shapes, and 3. On the partition separating the scala media from the scala vestibuli is the membrane of Reissner. Wandt believes that different tones affect different parts of the nerve of hearing thus disposed, and that, as elastic bodies respond each to some particular tone, and remain quiescent when other tones are sounded, so the elastic tooth-shaped pairs of rods of Corti, together with the superposed laminæ, are divided into groups responsive only to the stimuli of given notes, so that every fraction of a tone which a well-trained ear is capable of recognising is

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represented by its separate nerve fibre. Thus it is thought the fibres of Corti are like tuning forks, set vibrating each by a particular sound wave, and that each affects a particular fibre of the cochlea nerve only. It must be understood, however, that this explanation is only hypothetical, and still awaits definite proof.

It will be seen that two of the cochlear scalæ receive vibrations directly from the vestibule, viz.: the scala vestibuli from the perilymph, and the scala media from the endolymph. The scala tympani has been supposed by some to receive vibrations through the fenestra rotunda directly from the tympanum; whilst by others it is thought more likely that vibrations descend it after having passed the scala vestibuli. I should conclude that it is affected in both these modes, though but slightly by the first.

The auditory nerve, called from its softness the *portio mollis* of the seventh pair, is marked by the fineness of its component fibres. It enters the labyrinth by the internal meatus, where it subdivides into two branches, one supplying the vestibule, and the other forming the cochlear nerve. The ultimate terminations of the nerve-fibres in the cochlea have not yet, I think, been definitely traced, though it is almost certain that some of them end in the organ of Corti.

Having now sketched the anatomy of the organ of hearing, it remains for us to consider a little more in detail some parts of the physiology of hearing not noted in connection with the foregoing anatomical considerations. According to popular conception the pulsations of air upon the tympanic membrane are the necessary antecedents of sensations of sound; but this appears to be disproved by the following:—A *drum* is silent if the skin be burst, because the skin is its only effective vibrating surface; but the tympanum is not properly a drum, inasmuch as its membrane may, according to Cheselden, be burst, not only without destroying hearing, but even in some cases with a terrible *increase* in susceptibilty to sounds. Cheselden destroyed the membranes in dogs, and found that they were terrified at all loud sounds; and there is a case on record of a man with a hole in his tympanum, to whom the whistling of another man in an adjoining room was intolerable (G. H. Lewes).

Still it is clear that the vibrations of the tympanic membrane are of great assistance in hearing, as it is found that a thickening, or stiffening of it, or even unusual dryness, will render hearing dull. Many a temporary deafness has been removed by well syringing the ear with warm soap and water (although in such cases the removal of indurated wax,

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which had occluded the external canal, may often count for more than the lavement of the membrane), or by removing the obstruction caused at the pharyngeal end of the eustachian tube by the congestion of the surrounding tissue, the accumulation of mucus, &c., and thereby facilitating the vibration of the membrane.

Against this statement that the tympanum is not really a drum Dr. Edward Clarke (quoted by Brown Sequard, "Journal de la Phys.," i., 644) adduces his observations of seventy-five cases of perforated membranes, with the following results:—

Tick of watch not heard in	5 cases	Normal limit of hearing about 14 ft. (Clarke.)
Only heard when close to ear	11 ,,	
Only within distance of 6 to 12 inches,	16 ,,	
Only within 4 feet	43 ,,	

There is, however, a source of fallacy in these valuable observations—It seems to have been forgotten that only one tympanum was perforated in his subjects, and therefore, if there were no other aural defects, they ought to have been able to recognise the tick of a watch with the sound ear anywhere within 14ft. If they could not, their defective hearing might reasonably be attributed to causes other than a perforated tympanum. [The watch used in the experiment must have been one of the portly forms worn by our great grandfathers.]

The *modus operandi* of hearing may be summarised somewhat as follows. The aerial waves proceeding from the vibrating body are collected by the pinna of the ear, focussed by the concha. and conducted into the external meatus, where they strike upon the tympanic membrane, producing vibrations in it. The vibration of this membrane causes the process of the malleus attached to it to swing at the same rate; the head of the malleus consequently turns through a small arc on its pivot (the *processus gracilis*). But the turning of the head of the malleus involves that of the head of the incus upon its pivot (the short process). Hence the long process of the incus swings through an arc estimated as about two-thirds that described by the handle of the malleus, the decrease in the extent of the push being compensated for by a proportional increase in force, which is an advantageous change in so confined a space as the tympanum. The long process of the incus being articulated with the stapes, involves this bone in its movements, pulling it out of and pushing it into the fenestra ovalis with equal rate and force. But every pull and push of the stapes imparts a corresponding set of shakes to the perilymph, which fills the bony labyrinth and cochlea external to the membranous labyrinth

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and scala media. These shakes are transmitted to the endolymph through the membranous envelope, and by the aid of the otoconia (or otolithes) and fibres of Corti are finally converted into impulses, which act as irritants of the ends of the vestibular and cochlear terminations of the auditory nerve.

The labyrinthine fluids are, it would seem, also in a measure agitated by sound waves travelling through all parts of the skull (though most of these are, doubtless, so dissipated as to produce no appreciable effect). As examples of sounds transmitted through the skull we may quote the well-known case of applying the stem of a vibrating tuning fork to the teeth, &c., and the production of "big bells" by the kitchen poker, suspended from a string, held at each end by the index finger closing the entrance to either ear. An eminent London Aurist also quotes, as an illustration, the opening of the mouth in cases of rapt attention to a discourse, music, &c. He considers that in this state hearing is assisted by sound waves being able to reach the tympanic cavity through the eustachian tube, and thus compares it to the cetacean "backward" hearing, noted above. I should also consider this as an example in point, although, in common with the relaxation of other members in states of rapt attention, &c., it may also be explained by reference to the effects of absorbing object regards, and is noticed in cases of concentrated attention generally,—but, as the pharyugeal end of the Eustachian tube is almost closed by its projecting lips, except during swallowing, and the soft palate offers an obstacle to the passage of sound waves. I should be more inclined to attribute any improvement in hearing in this case to the transmission of saund vibrations through the teeth.

The character of sound sensations of course depends greatly upon the nature of the originating vibrations, whether rapid or slow, intense or delicate.

The three physical peculiarities of sonorous impressions are:—

I. *Intensity* and *Quantity*—loudness or feebleness, and volume of sound.

II. *Pitch*—or note sounded.

III. *Quality*, *timbre*, or *klang*—the difference between sounds of the same pitch proceeding from different sources.

I. *Intensity*, supposed to be discriminated by the parts of the labyrinth other than the rods of Corti, depends directly upon the degree of stimulation. Above a given point the effect becomes pungent, like the action of ammonia on the

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nose, and may, to fresh and vigorous nerves, give pleasurable excitement for a time; but when long continued, or rising still higher, the sensation becomes painful, *e.g.*, the screeching in a parrot house, the shrill barking of small dogs, the whistling of boys in the street, the sharpening of a saw, &c. In most of these cases, however, the element of dissonance unites with the smarting of the sound.

(To be continued.)

THE LEICESTERSHIRE FORMS OF *CAPSELLA BURSA-PASTORIS.**

BY F. T. MOTT, F.R.G.S.

Capsella Bursa-Pastoris is one of the commonest weeds in all parts of Europe, and has spread itself over at least one-third of the habitable globe. Being an annual, very hardy, flowering at nearly all seasons of the year, and ripening its seeds abundantly, it has every chance of perpetual hybridization, and its "forms" are as numerous as those of *Cratægus oxyacantha*. Some of these forms will probably in the course of future ages become isolated under special conditions, will diverge further from the type, and will ultimately settle down into distinct species. At present, I do not think that any of the European forms can be regarded as more than varieties. A few of them may be fairly distinguished by certain extreme characters, but they are all linked together by innumerable intermediates, and probably no one of them would come true from seed sown under varying conditions. Koch, in 1843, made four varieties from the shape of the root-leaves. Jordan, in 1864, described six forms which he considered to be good species, distinguished partly by the leaves and partly by the flowers and capsules. Crépin distinguished three varieties by the capsules alone; and lastly, Mr. C. P. Hobkirk, now of Dewsbury, a well-known and very acute botanist, published in 1869 a memoir upon the genus *Capsella*, in which he admits six *sub-species* founded on the flowers and capsules only. Mr. Hobkirk has generously placed in my hands a copy of his memoir, from which I have derived

* Transactions of Section D of the Leicester Literary and Philosophical Society. Read October 15, 1884.

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much information, and a fasciculus of specimens, and tells me he now thinks that some regard should perhaps have been paid to the variations of the root-leaves. Mr. Hobkirk's descriptions are full and clear, but as he remarks that he does not find his specimens to agree precisely with the diagnoses of M. Jordan, so I find that my Leicestershire specimens do not quite tally with the descriptions in Mr. Hobkirk's memoir. This seems to be a further indication that these "forms" are of a temporary and uncertain character, much influenced by local conditions.

Taking into account both the leaves and capsules, I find among a considerable number of specimens collected in this county the following extreme forms sufficiently distinguishable, while the rest run in between them with a complexity of cross characters forming a confused network which defies classification.

SECTION A.—RADICAL LEAVES MOSTLY LYRATE OR PINNATIFID.

Var. 1.—*Gracilis.* Radical leaves rather thin, toothed, lyrate or pinnatifid, capsule small, obovate, notch none.

Var. 2.—*Densifolia.* Radical leaves firm, short, closely pinnatifid in a dense rosette, capsule forming nearly an equilateral triangle, notch shallow, lateral margins convex. On walls and in dry places.

Var. 3.—*Stenocarpa lyrata.* Radical leaves thin, toothed or lyrate, capsule long, narrow, obovate, notch moderate, lateral margins convex, lobes not divergent.

Var. 4.—*Stenocarpa coronopifolia.* Radical leaves thin, pinnatifid, pinnæ acute with the front margins toothed, capsule long, narrow, obovate, notch moderate, lateral margins convex, lobes not divergent.

Var. 5.—*Brachycarpa.* Radical leaves rather firm, toothed lyrate or pinnatifid, capsule forming an equilateral triangle, notch shallow, lateral margins straight. This may perhaps be the typical form.

SECTION B.—RADICAL LEAVES MOSTLY ENTIRE OR TOOTHED, RARELY PINNATIFID.

Var. 6.—*Rubellæformis.* Radical leaves rather firm, entire or toothed, capsule forming an isosceles triangle, notch moderate, lateral margins concave, giving to the lobes a slightly recurved appearance. In the true *rubella* the recurved character of the lobes is more distinctly marked.

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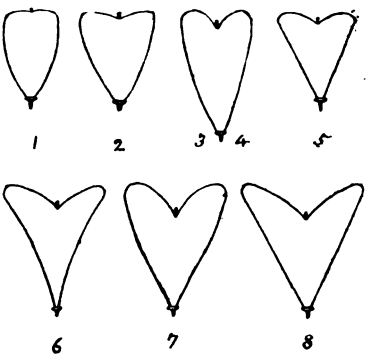
Var. 7.—*Macrophylla*. Radical leaves thin, pale green, 8in. to 6in. long, ½in. to 1in. broad, lanceolate or ob-lanceolate, entire or toothed, capsule forming an isosceles triangle, large, notch deep, lateral margins slightly convex, lobes not very divergent.

Var. 8.—*Bifida*. Radical leaves thin, scarcely so large as in the last, almost entire, capsule large, forming an isosceles triangle, notch deep, lateral margins straight, lobes widely divergent.

The annexed cut shows the seven forms of the capsule.



For some of the above forms I have adopted names which have been already used to represent the same leading characters. The names of *densifolia*, *lyrata*, *brachycarpa*, and *rubellæformis* have not been hitherto in use in this genus, but they express to some extent the principal features of certain extreme forms in my collection.

In admitting so many as eight distinct forms I have simply followed Nature as she appears in the examples before me. After sorting these out repeatedly, I find these eight extreme types clearly distinguishable, while in the rest the various characters seem to be promiscuously combined.

I think the characters I have given are sufficiently obvious to make it easy for other botanists to correlate their specimens, and it would be very instructive to know how the forms which may be common in other counties tally with those of Leicestershire. One remarkable character seems to be deducible from a study of these forms, viz.: that in this genus there is some connection between the notching of the capsule and the toothing of the leaves. Where the leaves are deeply cut the notch of the capsule is comparatively shallow, and where the leaves are entire the notch is deep.

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The notch depends upon the elongation of the upper extremities of the two valves of the capsule, which elongation takes place mostly after the fading of the flower. In the young capsules the notch is always less marked. Now an entire leaf generally indicates greater vegetative energy than a divided one, the divisions being probably caused by a deficiency of material. A vigorous form, therefore, will have a tendency to entire leaves and ample growth of capsule, the lobes elongating freely and producing a deep notch.

The length of the style, and the minute variations of the calyx, which are used by some writers in characterising the varieties of *Capsella*, do not seem to me of much practical value.

That the variations are not mostly due to varieties of soil is evident from the fact that of these eight forms, all but 1 and 2 may be found growing intermixed in my own kitchen garden. *Densifolia* may be a stunted form peculiar to dry situations, and *gracilis* is supposed by Jordan to be a barren hybrid, its small undeveloped capsules being generally sterile.

THE GEOLOGICAL STRUCTURE OF THE TITTERSTONE CLEE HILL.*

BY THE REV. J. D. LA TOUCHE.

It is hardly necessary for me to remark, for it is fully admitted by all who have studied the subject, that the rocks which lie scattered around us here, and of which this hill is chiefly composed, are of igneous origin—that they have been at one time in a state of fusion. In fact it is possible to re-melt them, which cannot be done with sedimentary rocks, and some years ago it was attempted to mould this basalt into ornamental form for architectural purposes; but as it was found that the surface soon weathered into an unsightly rusty brown, the project was given up.

It may perhaps be of interest to describe the principal features of these igneous rocks. They are by Sir C. Lyell divided into two chief classes: 1st, those which have been poured out over the surface of existing land, or intruded between strata at no great distance from the surface, or

* An address delivered to the Caradoc Field Club on the occasion of their visit to the Hill, May 19th, 1885.

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deposited under water—these he terms *Volcanic*; and 2ndly, those which have been formed at immense depths below the surface, which he names *Plutonic*.

We have before us an example of the first. Of the volcanic class of rocks there are again two main divisions, the *basaltic* and the *trachytic*; the first of these are distinguished by the comparative smoothness of their texture and their breaking with a conchoidal fracture, while the trachytic are rough to the touch owing to the quantity of granular felspar which usually enters into their composition. There is, besides, an important difference in the constituents of them, since, while basalt contains silica or quartz in but small quantity, *i.e.*, something under 50 per cent., trachyte is much more rich in that mineral ranging up to 60 and 70 per cent. And here I may observe that a corresponding difference exists in the two classes of plutonic rocks which correspond to those of the volcanic. Syenite bears much the same relation to basalt which granite does to trachyte. The former is often entirely deficient in silica, whereas in granite its presence is conspicuous. While, however, these distinctions hold as a general rule, a transition from one class to another may often be observed.

The term trap is derived from a Swedish word, trappa, which means a flight of steps; and has been applied to this form of igneous rock from the fact that it frequently occurs in successive terraces, rising above each other in the form of steps. Some seven minerals enter into its composition, viz., silica, alumina, iron, magnesia, lime, potash, and soda. The proportion of these vary considerably, as they do in modern lavas, even in those which have been ejected from the same crater. To account for this fact it has been suggested that when a volcano is in action the lighter portions of the molten rocks, the felspathic trachytes, are first ejected; while the tcasor, or the basalt, is the last to make its appearance, issuing in streams pushed through the superincumbent strata, as here.

In many places basalt is seen to assume a distinctly columnar form. This may be observed in those parts of the Clee Hills which are quarried, as well as in the shapes of the numerous blocks which lie around. The number of angles of these prisms varies from three to twelve, but is commonly from five to seven. The dimensions of these columns are very variable. Sometimes they attain a length of 400 feet, sometimes of only an inch or two; their diameter also varying from 9 feet to an inch. It is a remarkable fact that their axis is always perpendicular to the surface on which the lava

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stream has been deposited, so that—as is well seen in a section of a valley near Ontraigne, in the department of Ardéche, the columnar structure, which is vertical at the bottom of the valley becomes nearly horizontal along its sides. The columnar is not, however, the only form in which this rock is found. In many instances it assumes the appearance of spherical masses resembling cannon balls. I have observed this structure on a very large scale in Natal, where basalt exists through vast tracts of country. An example of the same may also be seen near the Breidden, where also you will find abundant specimens of porous cellular lava, which, when the almond-shaped cavities with which it abounds have been filled by the infiltration of some other material, is called amygdaloid.

You have within the limits of Shropshire good opportunities of studying ancient volcanic phenomena. Corndon is an example of an extinct submarine volcano. All round that hill you find ridges of felspathic ash alternating with shale, telling us of a time when, just as in the present day, showers of stones and ashes are projected from a crater and spread out at the bottom of the sea. A period of rest then takes place, during which the shale (often fossiliferous) is deposited. The Breidden and the Clee Hills, on the other hand, are instance of intrusion; and at Lincoln Hill, near Wellington, you may observe a fine example of a basalt dyke, a mass of molten rock having insinuated itself between the joints of the already deposited strata.

And now a word as to the age and conditions of this outburst of volcanic matter. We are now looking westward across an undulating plain; those successive ridges of hills which you see below us represent the various members of the Silurian formation, and bounding our view to the N.W. you see the Longmynd Hills, the representative of a still earlier epoch, viz., the Cambrian. All these were deposited many ages before the Devonian or Old Red which occupies the nearer ridges, and lastly, the Carboniferous, of which these hills are composed. Finding, then, as we do, that the basalt on which we now stand has spread out over the last-named stratum, the inference is inevitable that its age is subsequent to that of the coal period. That these hills, however, were, as has been, I believe, supposed by some, the site of an extinct volcano is very doubtful; and I quite agree with Mr. Yates, who has studied the subject from a practical point of view, that the evidence is rather in favour of an intrusion of molten matter between the strata, and that the more recent rocks which once overlaid the coal measures have been sub-

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sequently removed by denudation. There is every reason to believe that the two Clee hills have been at one time continuous, and that the valley between them has been caused by denudation.

It is not easy to form a very clear idea of the vast natural operations of which I speak, and to some I fear my words may seem to partake of romance and imagination. Yet, you must remember what may possibly be going on at this very moment, unknown to us, in some quarter of our own globe. Sitting, as you are now, among these rocks, amid this peaceful scene, it is not easy to realise the fact that there are spots on the surface of the earth which are the scene of the most violent convulsion; that there are at this moment, in Hawaii, lakes of molten lava some twelve miles long, in a state of fusion, and that, without any perceptible disturbance whatever to this quarter of the earth, only a year or two ago a mountain in Java, some 2,000ft. high, was projected twelve miles into the sea. Again, so lately as the year 1783, a stream of lava issued from Skaptur Jokul, a mountain in Iceland, which, separating into two portions, extended altogether to a distance of ninety-eight miles, filling valleys varying in breadth from a narrow gorge to fifteen miles, and in depth from 100ft. to 600ft. Cast your eyes over the valley which lies beneath us, and fancy a stream of molten matter not only filling it but extending two-thirds as far as London is from here, and thus you may obtain a practical idea of the vast operations which are going on even in the present day.

The question is often asked, what underlies—what are the foundations of all the rocks which compose the earth's crust? and it was long supposed that they must be of igneous origin. Later discoveries have, however, tended to modify this opinion. That our globe has been the gradual condensation of nebulous matter in a state of intense heat, and that immense volumes of molten matter exist within the bowels of the earth there is every reason to believe. Yet we are unable to say of any mass of granite or basalt that in it we behold the primordial floor on which all subsequent formations have been laid down; since sedimentary strata of every age are found penetrated by these volcanic rocks, which have, therefore, been obviously formed subsequently to the deposition of the others. All we can say is that so far as we can judge there are evidences of a series of operations extending to a distance in past time which is practically infinite, and in which the deposition of rocks from water, their denudation by atmospheric agencies, and outbursts of volcanic matter, have gone on concurrently from time to time.

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MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

EIGHTH ANNUAL MEETING, BIRMINGHAM, 1885.

The Eighth Annual Meeting of the Union was held at Birmingham on the 16th and 17th June. Unfortunately the attendance from other towns was but small, although the local Societies had made excellent arrangements for Meetings, Conversazione, and Excursions.

The Council Meeting, held in the Council Chamber of the Birmingham Corporation, by kind permission of the Mayor (Ald. T. Martineau), was attended by fifteen delegates. Reports were read from the Secretaries, Management Committee, and Treasurer. It was resolved that in order to open the way for the admission of such Scientific Societies as are not strictly Natural History Societies, the name of the Union be altered to "The Midland Union of Natural History and Scientific Societies."

After the Meeting of the Council, the President of the Union (R. W. Chase, Esq.) entertained the delegates and a number of other gentlemen at luncheon at the Grand Hotel.

The Annual General Meeting was held (by the kind permission of the Bailiff and Council) in the Examination Hall of the Mason College. In addition to the delegates, there were a number of members and friends present—among them the Rev. H. W. Crosskey, Messrs. W. H. France, Robt. Chase, Miss Taunton, Miss Jermyn, Mrs. Potts, Birmingham; Herbert G. Young, of London; H. Pearce, Stourbridge; E. George, Northampton; H. E. Forrest, Shrewsbury; Rev. W. H. Painter, and others.

The President of the Union, R. W. Chase, Esq., was in the chair, and read a very interesting Address on the work of Natural History Societies, and on some special points in the science of ornithology, of which he is a most assiduous and successful follower. The thanks of the meeting were heartily voted to him for the Address, and he was requested to allow it to be published in the "Midland Naturalist."

The Annual Report was then read and adopted, and ordered to be printed in the "Naturalist." Mr. A. W. Wills then moved, Mr. W. R. Hughes seconded, and it was resolved, that Messrs. A. W. Wills, E. W. Badger, and Professor W. Hillhouse be requested to take steps to circulate the appeal on the subject of the preservation of rare plants which is embodied in the Annual Report.

REPORT OF THE COUNCIL.

Societies in the Union.

During the past year the composition of the Union has undergone but little change. The Shropshire Archæological and Natural History Society and the Oxfordshire Natural History Society have withdrawn from the Union, but the Council is gratified to announce that the Rugby School Natural History Society, which for a short time belonged to the Union and then seceded, has decided to re-enter it, so that the list of the component Societies will now stand as follows:—

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Bedfordshire Natural History Society and Field Club.
Birmingham Microscopists' and Naturalists' Union.
Birmingham Natural History and Microscopical Society.
Birmingham Philosophical Society.
Birmingham and Midland Institute Scientific Society.
Birmingham School Natural History Society.
Caradoc Field Club.
Dudley and Midland Geological and Scientific Society and Field Club.
Evesham Field Naturalists' Club.
Leicester Literary and Philosophical Society.
Northamptonshire Natural History Society.
Nottingham Naturalists' Society.
Nottingham Working Men's Naturalists' Society.
Oswestry and Welshpool Naturalists' Field Club.
Peterborough Natural History and Scientinc Society.
Rugby School Natural History Society.
Severn Valley Naturalists' Field Club.
Tamworth Natural History, Geological, and Antiquarian Society.

Work of the Year.

Of the Work of the Societies during the year there is little of general interest to report. Most of the Societies publish separate transactions, but we think there is an increasing disposition to use the "Midland Naturalist" for the purpose of publishing observations and suggestions.

The Leicester Literary and Philosophical Society, Section D. (Zoology and Botany), and the Nottingham Naturalists' Society are especially to be congratulated upon the praiseworthy attempt they are making to enable the "Midland Naturalist" to better fulfil one of the purposes for which it was established, namely, to be a means of making more widely known what is being done by the various Societies in the Union.

Midland Naturalist.

The numbers of this periodical which have appeared since the last report have, we consider, fully sustained or more properly enhanced its reputation, and the editors—Messrs. W. J. Harrison and E. W. Badger—deserve the thanks of all our members for their energy and activity in the office they hold. It is, however, obvious that a still larger number of Societies might, with advantage, contribute to its pages, the amount of matter on hand being still but seldom equal to the monthly demand.

The Council also take this opportunity of thanking those persons, especially the Committee of the Birmingham Natural History and Microscopical Society, to whose kindness they owe the illustrations with which the "Midland Naturalist" has been recently enriched.

The principal articles published in this Journal since the last report are as follows:—

The Preservation of Native Plants, by A. W. Wills; Botanical Notes in connection with the Peterborough Meeting, by Rev. M. J. Berkeley and G. C. Druce; Address of the President, Rev. J. J. S. Perowne, on the Repairs to Peterborough Cathedral; Study of a Lichen from Oban, by W. H. Wilkinson; *Lunularia vulgaris*, by Rev. H. P. Reader; On the Mammals of Leicestershire, by F. T. Mott; On the Zygnemaceæ: a Chapter in the History of Fresh Water Algæ, by F. Bates; A Fungus Foray in the Middleton District, by J. E. Bagnall; Penmaenmawr, by T. H. Waller; Report on Marine

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Sponges Dredged at Oban, by H. J. Carter; On the Structure of Mosses, by F. T. Mott; Breaking of the Meres, simulated by an excessive development of *Uroglena Volvox*, by Wm. Southall; *Floscularia mutabilis*, by Dr. C. T. Hudson; On the Best Methods of Studying Botany for Beginners, by F. T. Mott; On the Pre-carboniferous Floor of the Midlands, by W. J. Harrison; On the Development of a Fern from its Spore, by G. C. Turner; Koch's Comma Bacillus, by W. B. Grove; The Lias Marlstone of Leicestershire as a Source of Iron, by E. Wilson; On the Nervous System of Vegetables: Do Plants Feel? by F. T. Mott; The Life-history of a Filiform Alga, by Dr. M. C. Cooke; The Physiology of the Medicinal Leech, by Prof. J. B. Haycraft; Notes on Two Rare Annelids, by T. Bolton; The Ear and Hearing, by W. J. Abel; The Middle Lias of Northamptonshire, by B. Thompson; On the Intercellular Relations of Protoplasts, by Prof. W. Hillhouse; Notes on the Mymaridæ, by F. Enock; Roraima Mountain, by W. P. Marshall. The Flora of Warwickshire, by J. E. Bagnall; The Pilobolidæ, by W. B. Grove; and the Exposition of the Principles of Biology, by various members of the Sociological Section of the Birmingham Natural History Society, have also been continued. The Council are pleased to observe that while most of the old contributors maintain their ground, the names of several new and energetic workers are added to the list.

Darwin Medal.

The subject for the Darwin Prize for this year, 1885, is Geology, and the Management Committee requested the services as adjudicators of the following gentlemen, who all courteously consented to examine and report upon the papers which were eligible for the competition, viz.:—Professor A. H. Green, of Leeds; Professor J. W. Judd, of London; Professor T. G. Bonney, of Oxford; Professor C. Lapworth, and Dr. H. W. Crosskey, of Birmingham.

Mr. C. J. Watson was requested to act as Secretary to the adjudicators. On his report to the Council of the opinions given by the adjudicators it was decided that a medal be awarded to our late Honorary Secretary, Mr. W. J. Harrison.

Prizes for Photography.

The subject of offering prizes for Scientific Photography has been under the consideration of the Committee, but they report that they have decided that the state of the funds of the Union will not permit of such a step being taken at present. The Council, nevertheless, wish to direct the attention of the members to this important branch of scientific work. Although very frequently something more of the nature of a diagram is required for the illustration of a paper, yet they are sure that a good photograph would in many cases prove preferable to any engraving for the "Midland Naturalist."

Some of the Societies of the Union have already derived benefit from the much more popular form of photography available at the present day; and have had the opportunity of seeing photographs taken by members of the Societies during visits to America on the occasion of the meeting of the British Association in Montreal. The tourist who can bring back, impressed on his dry plates, pictures of the natural wonders of Niagara, or of the Yellowstone Park, from the points of view which have specially captivated his own eye, has laid up for himself and his friends a pleasure which published photographs rarely give, while the simplicity and ease of performance of the requisite processes permit him to photograph scenes which, without

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any such interest as would attract a professional artist, yet by their personal associations, or from temporary causes, have become interesting to himself.

Preservation of Native Plants.

The lamentable results of the unchecked eagerness for collecting rare or specially beautiful plants have already been brought to the notice of the members of the Union by the paper on the subject by Mr. A. W. Wills, in the "Midland Naturalist" for August, 1884. The subject has been under the consideration of the Management Committee at each of its meetings, and as the result the Council recommend that the following appeal be adopted by the Annual Meeting, and that Messrs. A. W. Wills, E. W. Badger, and Prof. W. Hillhouse be requested to take the necessary steps to bring it under the notice of the Natural History Societies of the country and of the public generally.

Appeal.

It is a fact only too evident to the most superficial observer that many of our rarest and most beautiful native plants have already been or are being rapidly exterminated; and it may be assumed that this extermination will be viewed with regret—even with indignation—alike by the student and by the ordinary lover of natural beauty, and that both will be willing to assist, by all available means, in any measures which may afford the prospect of arresting its course.

The Council of the Midland Union of Natural History Societies asks serious attention to the following brief statement of the causes of the rapid destruction of British plants, and of what it ventures to suggest as the best means of mitigating the evil.

These causes appear to be mainly as follows:—

First.—The ravages of professional plant-hunters, who offer to the tourist or to the general public, by advertisement, plants attractive by reason of their beauty or of their comparative or absolute rarity.

The large dimensions which this traffic has assumed are indicated by the number of such advertisements which appear in some of the gardening periodicals, offering ferns from Devonshire, Cornwall, Somerset, the Wye Valley, &c., at from 4s. to 7s. 6d. per 100, in named varieties; *Hymenophyllum tunbridgense* and *H. unilaterale* at 2s. per square foot; various species of Orchis, Saxifrage, &c., at from 2s. to 5s. per 100; Bog Asphodel at 2s. per doz.; or inviting tenders for Primroses and Daffodils at so much per 100,000.

Second.—The operations of Exchange Clubs, the members of which are often asked to supply large numbers of the rare plants of their own districts in exchange for corresponding quantities of those of other neighbourhoods.

Third.—The indiscriminate or careless gathering of plants, often taken with their roots or in seed, by Botanists and their students in the course of botanical excursions.

Fourth.—The reckless gathering of large numbers of specimens by individual botanists.

Recognising that restrictive legislation or police interference are neither applicable nor desirable, the Council believes that it is by the indirect influence of example and the promotion of healthy public opinion that the evil in question can alone be combated.

They therefore earnestly urge the following considerations upon botanists, members of Field Clubs, Natural History and other Scientific Societies, upon all lovers of Nature and upon the public generally:—

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First.—That they should rigidly abstain from encouraging or countenancing the purchase from professional plant-hunters of any native plants, for the sake either of their rarity or of their decorative value.

Second.—That botanists should resort to the assistance of Exchange Clubs, if at all, only for the purpose of obtaining single specimens necessary to fill up blanks in their herbaria, using such assistance with discrimination, and excluding from their operations plants of great rarity.

Third.—That all teachers should inculcate upon their pupils, by precept and example, the lamentable consequences of the wholesale or indiscriminate gathering of plants, especially with their roots or when in seed.

Fourth.—That individual botanists should seriously reflect on these consequences, and abstain from taking more than the smallest number of specimens indispensible for the purposes of genuine study, and even from taking any where the extermination of a particular species from a restricted habitat is threatened.

Fifth.—That tourists and amateurs should be urged to refrain from collecting plants of any degree of scarcity, especially when in flower or seed, it being impossible that ten per cent. of those gathered under such conditions can possibly live after removal.

Finally, the Council earnestly appeals to the editors of all journals devoted to Science and Art as well as to Horticulture and Floriculture and to those of the leading London and provincial papers to assist it in creating a healthy public opinion on this subject by the expression of their sympathy with the effort which the Council is making, and by refusing insertion to advertisements from professional plant hunters.

The Committee hearing that a Society has been formed in Geneva for the preservation of Alpine plants, adopted the following resolution, which was sent to the Secretary, from whom a number of the publications of the Society has been received.

Resolution—"The Committee of the Midland Union of Natural History Societies, deeply regretting the extermination of many of the native plants of Switzerland, desires to express its sympathy with the Société pour la Protection des Plantes, and to pledge the members of its own societies to contribute by all means in their power to the cause of the preservation of the native flora of that glorious land which has been the resort and the delight of so many of themselves and of their countrymen."

Review of Progress.

In conclusion the Council wish to thank the Birmingham Societies for the excellent arrangements which they have made for the comfortable holding of the meeting of the Union; and feel that the second meeting in Birmingham affords an opportunity for looking back to the former meeting there in 1878, and for considering how far each of the component societies has grown since then, and how far they are now fulfilling the objects for which they then entered into association. While regretting that the apathy of the members, to which attention was directed in the last report still exists, the Council think they can see signs of a little improvement, and hope that all who are interested will try to do their utmost to further the progress of the Union. The need of the Union will mainly be felt by active workers—those who are trying to engage in some scientific investigation, in which they feel the necessity of the help and approval of their fellow-workers. To these, when they belong to

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societies not publishing separate transactions of their own, the "Midland Naturalist" offers a ready means of communication with others, and it would be instructive to have the testimony of those whom the papers and notes in this journal have put *en rapport* with those at a distance who take an interest in the same pursuits. The Council are confident that the number of members who could thus testify to the usefulness of the Union would be no small one. They would invite any, who complain that their wishes are not met by what the Union has hitherto done, to make suggestions and propose improvements; but, at the same time, they would repeat that what is especially wanted, is a more extended and genuine interest in real scientific work, and the attention of the Societies in the Union should be directed to the spreading of this feeling among their members. If this were successfully done, there would at once result a larger attendance at the Annual Meetings, and more valuable contributions to the "Midland Naturalist," and the Union would be able to take the position which was intended by its projectors, as a real Midland Association for the Advancement of Science.

In the discussion on the adoption of the Report and on Mr. Wills's motion several members took part. A suggestion was made that the Union should be made the medium for more intercommunication of lectures and papers among the various Societies composing it. No formal vote was taken on this particular point, but there seemed an agreement that such an arrangement was desirable, and as the programmes for the Autumn Meetings will probably be soon in process of compilation, the Hon. Secretary will be glad to receive the names of gentlemen willing to visit Societies for the purpose of delivering lectures or reading papers if desired. Between Tamworth, Burton, and Birmingham there has already been such interchange to a small extent. In the list of papers read to the Tamworth Society are two by Birmingham gentlemen and one by a representative of the Burton Society, while the Birmingham Natural History Society has had the benefit of a paper from a visitor from Tamworth.

The Honorary Treasurer, Mr. E. de Hamel, then read his report, which showed, with some small arrears yet due, a balance in hand of £3 2s. 11d.

Votes of thanks were then passed to the Officers of the Union, and to the Officers and Members of the Birmingham Societies.

Mr. E. de Hamel was elected Honorary Treasurer, and Mr. T. H. Waller Honorary Secretary for the coming year.

The meeting closed with votes of thanks to the Bailiff and Council of the Mason College for the use of the Examination Hall, and to the Chairman.

THE CONVERSAZIONE.

This, which was also made the Annual Conversazione of the Birmingham Natural History and Microscopical Society, was held in the Town Hall, on Tuesday evening, July 16th.

Undoubtedly the most important part of the display was the large and beautiful collection of British Birds exhibited in the Great Gallery by Mr. R. W. Chase, President of the Society, and also of the Midland Union.

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Many of these birds were very rare, including Rose-coloured Pastor, *Pastor roseus;* Snowy Owl, *Nyctea scandiaca*, from Caithness; Buffon's Skua, *Stercorarius parasiticus*, from Seaham Harbour; and Greenland Falcon, *Hierofalco candicans*, male and female, from Caithness. The most unique exhibits were a splendidly mounted pair of Golden Eagles, *Aquila chrysaëtus*, male and female, from Uig, and a pair of White-tailed Eagles, *Haliaëtus albicilla*, from Lewis. Another noteworthy specimen was a male King Eider Duck, *Somateria spectabilis*, from the Farne Islands, shot this year, and very rare. Among other rare specimens were also a Dartford Warbler, *Melizophilus undatus*, from Kent; an Osprey, *Pandion haliaëtus;* two Goshawks, male and female, *Astur palumbarius;* Sabine's Gull, *Xema Sabinii* (shot in Warwickshire); a Little Gull, *Larus minutus*, from Shoreham; *Motacilla flava*, and *M. alba*, Blue-headed, Yellow, and White Wagtails, from Brighton; *Sterna Dougalli*, Roseate Tern, from the Farne Islands; and *Hydrochelidon leucoptera*, White-winged Black Tern, from Norfolk. These cases were remarkable also for the fidelity with which they represented the details of the locality in which the birds were obtained. Mr. Chase also exhibited a large number of Eggs and Nests of British Birds, and over forty well-mounted pairs of Horns and Antlers from various parts of the world; also Nests of the Wood or Bush Wasp, and of the Hornet.

The floor of the hall was occupied by a display of about seventy microscopes, under which were exhibited many interesting objects, too numerous, however, to mention. Mr. T. Bolton exhibited an interesting collection of preserved specimens from Naples, illustrating Marine Zoology, and an example of Fish-hatching apparatus; Mr. G. St. John, an Observatory Hive, in which the Bees were seen at work; also Diagrams of the Anatomy of Bees, and their relations to flowering plants.

We can only make a selection from the exhibits in the side galleries. Mr. C. Beale, of Rowley Regis, showed a large number of Palæolithic and Neolithic Implements, including some rare ones in Jasper and Chalcedony, from Torontola, at the base of the Apennines; also some remarkable ancient Pottery, obtained from the old open coal workings at Tipton, Amblecote, and Wednesbury, attributed by the miners to the fairies. Mr. Beale also showed a large number of rare Fossils, from the Carboniferous and Silurian formations, many of them species not yet named. Mr. Horace Pearce, of Stourbridge, Crystals of Copper; Ammonites from the Lias, Whitby; Glacial Clay and Striated Stones; and specimens of erratic Boulders, etc. Mr. S. Price, a number of specimens of India-rubber from India, Java, Africa, &c., in various states of preparation; and foreign Butterflies, Moths, &c. Mr. H. L. Earl, M.A., of Sheffield, two Cases of Butterflies. Prof. T. W. Bridge, preserved specimens of Fishes, from the Mason College Museum. Mr. W. R. Hughes, a small collection of British and Foreign Corals, *Euplectella Aspergillum* (a beautiful sponge from the Philippine Islands), and *Spongia oculifera* (an allied fossil form). Mr. W. J. Harrison, Models used for teaching Physiology; also a number of Slides prepared for the Oxy-hydrogen Lantern to illustrate lectures; some Apparatus for teaching Electricity and Magnetism, devised by himself; and a simple arrangement for Photo-micrography; also Rocks and Fossils from the Coal Measures and Welsh Mountains. Mr. J. E. Mapplebeck, a large and well-arranged collection of living British Ferns, including many rare and novel varieties such as *Lastrea pseudo-mas Mapplebeckii*, and *Athyrium filix-fœmina minutissimum*, both found wild. Mr. W. H.

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Wilkinson, set of Lichens from the district and from Scotland, many of which were beautifully in fruit. Mr. W. B. Grove, a small collection of Fungi growing on trees; also some comic sketches of Fungus forays and Portraits. Mr. S. Walliker, living Mosses, Lichens, and Ferns, from Devonshire, and mounted Sea-weeds. Miss France, a plant of Edelweiss, in bloom. Messrs. C. and A. Pumphrey, a very large number of Photographic Slides, prepared for the Oxy-hydrogen Lantern, including instantaneous Landscape Views and Microscopical Objects. Messrs. Alderman White, J. H. Stone, C. R. Robinson, and C. J. Watson, a large number of Landscape and Geological Photographs. Mr. T. J. Baker, four Calorimeters, demonstrating the following thermal facts:—(a) Atomic weights of different metals at the same temperature contain equal quantities of heat; (b) Equal weights of different metals at the same temperature contain unequal amounts of heat; (c) The relative amounts of heat absorbed by dissolving equal weights of different salts in water. Professor J. H. Poynting, Interference of Light by the Biprism. Mr. A. W. Haines, a small Dynamo-electric Machine, with Model Pump attached. Mr. Thomas Clarke, War Medals, obtained in the campaigns in China, Africa, New Zealand, Afghanistan, The Peninsula, &c.

Around the floor was arranged a collection of Diagrams for teaching Physiological Botany, lent by Prof. Hillhouse.

In a separate room Mr. C. Pumphrey exhibited by the Oxy-hydrogen Lantern, at 8 p.m., a series of Photographs of the Yellowstone Park and Niagara taken by himself during his visit to Canada and the United States in 1884; and at 9 p.m., a number of Photo-Micrographs.

The Hall was illuminated by the electric light, and there was a fairly good attendance of visitors and members of the Midland Union, chiefly, however, those residing near Birmingham.

TEACHERS' CONVERSAZIONE.

On Thursday evening, June 18th, the Town Hall was crowded in every corner by the Elementary School Teachers of Birmingham and the immediate neighbourhood, who appeared to derive great pleasure from an inspection of the numerous and attractive exhibits. It was a happy thought on the part of the Birmingham Natural History and Microscopical Society to invite those who are engaged in the work of education in the town to examine the extensive display of natural history specimens, microscopes, &c., which had been got together as part of the eighth annual meeting of the Midland Union of Scientific Societies. About 1,500 invitations were issued, and from the throngs of visitors who filled the building as soon as the doors were opened it would appear that few, if any, of those invited were absent. Mr. Pumphrey's capital lantern lectures on America and on Photo-micrography were listened to with marked attention, and Mr. Chase's magnificent collection of British birds attracted general admiration. Every visitor appeared anxious to make the complete round of the grand exhibition of animate and inanimate objects displayed under the microscopes, and the exclamations of astonishment at the wonders revealed were neither few nor faint. From the general and obvious interest excited it cannot be doubted but that a most pleasant evening was spent by the teachers, and that they would carry away a better knowledge of the attractiveness of scientific pursuits than many of them previously possessed. As one connected with the teaching profession of this town, the writer desires, on behalf of his fellow teachers and at the request of many of them, to tender to the Natural History Society their earnest thanks. It crossed the minds of some

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how great a pleasure it would give to the elder children of our public schools if they, too, could have an opportunity of seeing some of the secrets of Nature, so well revealed! If the Society could see their way to do any such work—and they might well ask the town to help them—it would be sowing seed whose produce could hardly be over-estimated.

EXCURSION TO THE LICKEY HILLS.

The members who had chosen the excursion to the Lickey Hills left Snow Hill Station by the 10 a.m. train, and were joined at Old Hill by a contingent from Stourbridge. Mr. W. J. Harrison, F.G.S., acted as leader, and the party included the Rev. A. Watson, J. Grayston, F.G.S. (Tamworth), J. W. Bodger (Peterborough), Rev. G. St. Clair (Birmingham), Messrs. Marten, Worthington, Madeley, Perry, &c. (Stourbridge), Rev. J. H. Thompson (Cradley), being altogether about twenty in number. On getting out at Rubery Station, the fine section of quartzite, crossed by a well-marked fault, which is exposed in the railway cutting, was first examined. Walking southwards, the junction of the Llandovery sandstone with the quartzite (which is of either Cambrian or Pre-Cambrian age) in the road-cutting nearly opposite the asylum gates was next studied. The sandstone is crowded with casts of *Pentamerus*, &c., but the quartzite is quite unfossiliferous. The brook section in the asylum grounds came next, where the Silurian shales and limestones—resting on the Llandovery—are fairly well exposed. From this point the walk extended along the ridge to Rednal, many fine sections being seen on the way; south of Rednal the quartzite is fairly contorted, being here close to the line of fault which runs along the eastern side of the ridge. At Kendal End the patch of Silurian limestone—long since noted by Murchison—was found, and in the hollow where it lies some good plants delighted the botanists. Nearer to Barnt Green the party walked through the beautiful grounds of Barnt Green House (by kind permission of W. A. Thompson, Esq.), and found the Pre-Cambrian strata (volcanic rocks which *underlie* the quartzite) exposed along the brook course. At this point the party divided, some returning to Stourbridge, while the emainder took the Midland train from Barnt Green to Birmingham. The weather was excellent for walking—fine, but not sunny—and the day proved a very enjoyable one.

EXCURSION TO COVENTRY AND KENILWORTH.

An agreeable party of thirty-four, under the guidance of Mr. J. Levick, travelled in a carriage reserved for them by the L. & N.-W. Ry. Co., from New Street to Coventry, reaching the latter place soon after ten o'clock. Here they were met by Mr. W. G. Fretton, F.S.A., who conducted the party over this interesting city, and whose life-long study of the Archæology of England rendered him eminently qualified for this position. The party visited the site of the Cheylesmore Manor House; Grey Friars Spire, now attached to Christ Church, all that remains of the Franciscan Monastery; Ford's Hospital, the magnificent timber work of which was much admired; St. Michael's Church, with its lofty and graceful steeple, built of red sandstone, and upon which the touches of "Old Father Time" are only too clearly seen in the crumbling of the outer casing of this graceful fabric. St. Mary's Hall was a place of much interest to the party, with its tapestry, pictures, armour, and collection of ancient MSS. They then visited Holy Trinity Church, remains of the Benedictine

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Priory and Cathedral, remains of city walls and gates, St. John's Hospital, now the Free Grammar School, where the boys (who were enjoying their luncheon) were evidently as much amused at the curiosity of the party as the party was in viewing their ancient buildings. They next passed Batlake Hospital, and having inspected St. John's Church, they reached the Craven Arms Hotel, where a good luncheon was provided. At one o'clock the party left this historic city with feelings of increased veneration after the interesting survey they had made of its many remains of ancient times. They proceeded by coach and wagonettes along the Warwick Road, with its graceful avenues of oak, to Stoneleigh, where they alighted to view the ancient church. Driving past the Abbey, the magnificent seat of Lord Leigh, they proceeded through the Deer Park and Thickthorne Woods to Kenilworth. Here the services of Mr. Fretton were again most welcome, as he pointed out the various spots of special interest in those picturesque old ruins, recalling the eventful incidents connected with them. After viewing the remains of the Priory and the Parish Church, they reached the station, having spent a very interesting and enjoyable day.

EXCURSION TO CANNOCK CHASE.

This was attended by about sixteen persons, under the guidance of Messrs. J. Brown and W. B. Grove. On descending from the train, which, by the kindness of the L. and N.-W. Ry., was stopped at Anglesea siding for the purpose, the party was conveyed by the Cannock Chase Company's engine to No. 4 Colliery, which most of them descended. On reascending, Mr. W. H. Duignan led them through Court Bank Cover, where they saw the slag of the old iron workings and the oaks which were lopped for fuel. They then walked through Beaudesert Park to Castle Rings, a British fort on Cannock Chase, and saw the foundations of (probably) a Norman castle, which was, at any rate, partly built within the enclosure. After lunch at Hednesford, they returned to Birmingham by 6 15.

SCENES ON THE NORTH COAST OF AFRICA.

BY CLEMENT L. WRAGGE, F.R.G.S., F.R. MET. SOC.

I am now collating the notes and observations of my last voyage to Australia; and some account of the North African coast line may interest my friends in the Midlands.

As the "Maranoa" headed in for the Strait of Gibraltar, I obtained several sketches of Cape Spartel, and of the imposing mountainous ridge at the north-west extremity of the great African continent. Deeply did I admire the grandeur of these noble bluffs. Alternately, however, the coast is bold, low, and undulating; and here the wind action of sub-aerial denudation appears to have been in play. The sun's fierce heat also takes a part and is a substitute for frost in higher latitudes in weathering the rocks—wasted through long ages; and the undulations seem to be débris of a once higher range. After leaving Gibraltar a course was

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shaped direct for Cape Tennez, Algiers, and Cape Bon; and after passing the former point until we reached the Bight of Tunis, I obtained an almost uninterrupted view of the North African shore. I was charmed beyond measure with the wild, rugged grandeur of this coast line. East from Algiers the picture is unique and of one type. In front are the placid waters of the blue Mediterranean, dotted here and there with rude Arab boats, whose latteen sails bend gracefully to the balmy breeze. Then come shelving hills and undulations reaching up from the coast line, and clad with a scrubby vegetation, while volumes of smoke from charcoal fires may be seen wreathing slowly upwards here and there. Surveying this vista from the distant background towers a noble stretch of weird and grotesque mountain heights, with peaklets, knolls, and tops in almost every conceivable variety of shape and form, indicating a theatre of vast physical changes. A greenish haze hung on this occasion as a filmy veil about the lower parts of the range, while fleecy cloudlets of cumulus floated over the knolls as I had lately beheld them at Ben Nevis. Here again had weathering agencies carved a mountain chain unlike anything I had seen before, and I gazed at its rugged pinnacles with deep fascination.

THE FLORA OF WARWICKSHIRE.

AN ACCOUNT OF THE FLOWERING PLANTS AND FERNS OF THE COUNTY OF WARWICK.

BY JAMES E. BAGNALL, A.L.S.

(Continued from page 83.)

GRAMINA.—*Continued.*

BROMUS.

B. asper, *Murr. Rough Brome Grass.*
Native: On hedge banks and in bushy places. Common. July, August. Area general.

B. erectus, *Huds. Upright perennial Brome-Grass.*
Native: On roadsides and field borders in calcareous soils. Locally abundant. July.

H. Chesterton Hill! *Y. and B.;* canal bank, Newbold-on-Avon, *R.S.R.*, 1878; Tredington; Honington, *Newb.;* near Edge Hills; Compton Verney; Kineton; near Binton; Wixford; Exhall; Oversley, near the mill; Redhill; bridle Road, Billesley to Wilmcote; Drayton Rough Moors; Great Alne; Rowington; canal bank, near Napton-on-the-Hill.
b. villosus. Rare.
H. Near Chesterton Wood! *H.B.;* near Chadshunt; near Birdingbury Wharf.

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B. sterilis, *Linn.* *Barren Brome Grass.*
Native: On banks, roadsides, and in pastures. Rather common. June, July.
I. Sutton Park; Erdington; Middleton; Kingsbury; near Coleshill; lanes about Shustoke; near Arley Wood; near Knowle; Cornel's End, &c.
II. Warwick; Milverton; Kenilworth, *H.B.;* Honington; Tredington; Lambcote, *Newb.;* near Bidford; Oversley; Stratford-on-Avon; Lapworth; Leamington; Southam; Rugby; Newbold-on-Avon.

B. secalinus, *Linn.* *Rye Brome Grass.*
Colonist or casual: In cultivated fields, by roadsides, and on railway banks. Local, but widely spread. July to September.
I. On Dost Hill, near Tamworth, *Ray. Cat.;* near Over Whitacre; Coleshill Heath; Bassett's Green, near Berkswell.
II. Beauchamp's Court, Coughton, *Purt.*, iii., 10; Moreton Morrell, *Y. and B.;* Beavington Waste, near Salford Priors; Oversley, near the wood; Binton; near Stratford-on-Avon; rick yard, Kenilworth; pasture by Newbold-on-Avon.
b. velutinus, Sm. Rare.
II. Near Halford, *Newb.;* in a quarry near Binton Bridges.

B. racemosus, *Linn.* *Racemose Brome Grass.*
Native: In meadows and pastures, rarely by roadsides. Local, but widely spread. June, July.
I. Pasture, near Sheldon Church; Marston Green, in a sandy piece; meadow, near Elmdon; meadow, near Baulk Lane, Berkswell; Holdifast Grange Farm, Erdington.
II. Honington; Tredington, *Newb.;* on the new embankment near Brown's Over, *Blox., N. B. G. S.;* lane near Exhall; Salford Priors; Beavington Waste, near Salford Priors; Binton; Redhill; pastures, near Farnborough; Wawen's Moor, near Wootton Wawen.

B. commutatus, *chrad.* *Confused Brome Grass.*
Native: In pastures, meadows, and by roadsides. Local. June, July.
I. Meadows by Blythe Bridge, Solihull; Earlswood Reservoir.
II. Honington Park; Tredington, *Newb.;* Radway, near Edge Hills; Ashorne, path to Oakley Wood; Binton Bridges; Redhill; Billesley; near Studley Railway Station; roadsides between Brandon and Brinklow.
b. pubescens. Very rare.
II. Roadsides near Redhill.

The three foregoing grasses are often difficult to discriminate; all my specimens, however, have been carefully compared with typical specimens given to me by the late Hewett C. Watson.

Var. *multiflorus*, Parnell.
II. On roadsides and in cultivated fields. Abundant in 1879.

This is a marked variety, midway between *B. commutatus* and *B. mollis*. Prof. Babington considers it to be var. *multiflorus*, of Parnell.

B. mollis, *Linn.* *Soft Brome Grass.*
Native: On banks, roadsides, pastures, and meadows. Very common. June to August. Area general.

The variety *b. glabrescens* occurs frequently with the type, more especially on sandy banks, railway banks, and sandy roadsides.

[*Ceratochloa unioloides*, DC. Mr. Bromwich finds this occasionally near the skin yards at Kenilworth, probably introduced with foreign skins.]

(To be continued.)

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BOTANICAL NOTES FROM SOUTH BEDS,

WITH VOUCHER SPECIMENS.

Name.	Date 1885.	Date 1884.	Aspect. 1885.	Soil, Situation, &c. 1885.
Corylus Avellana ..	Feb. 1	Jan. 13	Open	Hedge. Both male and female flowers.
Tussilago Farfara ..	,, 8	,, 12	S.	Railway bank, same station both years.
Helleborus viridis ..	,, 15	—	Open	Meadow. Inflorescence & foliage only.
Draba verna	,, 21	Feb. 17	,,	Garden path.
Salix caprœa	Mar. 8	—	S. E.	Coppice. Female flowers.
Ranunculus Ficaria ..	,, 8	Mar. 6	Open	Coppice.
Primula veris	,, 15	,, 9	,,	,,
Anemone nemorosa ..	,, 15	,, 16	,,	,,
Potentilla Fragariastrum	,, 15	—	,,	,,
Helleborus viridis ..	,, 22	—	,,	Meadow. Expanded flowers, *vide* supra
Adoxa Moschatellina ..	,, 22	—	S.	Bank.
Cardamine hirsuta ..	,, 27	Mar. 6	West	Side of a stream. In fruit.
Caltha palustris ..	,, 27	,, 29	Open	Moist meadow. Same station both years.
Viola Riviniana.. ..	,, 29	—	N. E.	Hedge bank.
Nepeta Glechoma ..	Apr. 3	Mar. 29	S.	Bank.
Petasites vulgaris ..	,, 3	—	Open	Moist meadow.
Viola hirta	,, 11	—	W.	Hedge bank.
Viola Reichenbachiana..	,, 11	—	,,	,,
Anemone Pulsatilla ..	,, 12	—	S. E.	Chalk hills. Mr. J. Catt.
Prunus spinosa	,, 12	Mar. 16	S.	Warm hedge bank. Only a few blossoms
Cardamine pratensis ..	,, 21	Apr. 5	Open	Meadow.
Luzula campestris ..	,, 23	Mar. 30	S.	Luton Hoo Park.
Scilla nutans	,, 25	Apr. 6	S. W.	Coppice.
Ranunculus bulbosus ..	,, 25	—	,,	Railway bank.
Stellaria Holostea ..	,, 26	Mar. 23	S. E.	Warm bank. Comparatively late.
Ranunculus auricomus..	,, 28	Apr. 10	—	Luton Hoo Park. Mr. J. Catt.
Orchis mascula	May 5	May 4	Open	Coppice.
Sisymbrium Alliaria ..	,, 16	Apr. 19	,,	Side of a stream.
Pyrus acerba	,, 17	—	,,	Hedge row.
Cratægus monogyna ..	,, 17	May 11	S.	,,
Geranium Robertianum	,, 28	Apr. 10	S.W.	Hedge bank. Comparatively late.

Staminate Flowers of Mercurialis perennis were gathered as early as the last week of 1884.

J. Saunders, Luton.

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METEOROLOGICAL NOTES.—June, 1885.

Atmospheric pressure was unsteady, but not generally low, the mean being 30·050 inches. The highest reading was on the 11th, 30·402 inches; the lowest on the 20th, 29·449 inches. The mean temperature, 58·5°, was slightly below the average. There were some warm days at the beginning and middle of the month. The highest maxima occurred on the 4th, when 83·8° was registered at Loughborough, 82·5° at Strelley, 81·3° at Coston Rectory, 80·9° at Hodsock, and 80·5° at Henley-in-Arden. In the rays of the sun, 134·2° at Loughborough on the 4th, 132·1° at Strelley on the 28th, and 129·3° at Hodsock on the 15th. The lowest minima were 33·5° at Hodsock on the 27th, 34·0° at Coston Rectory, and 37·4° at Loughborough on the 11th, 38·0° at Henley-in-Arden on the 11th and 27th, and 38·5° at Strelley on the 27th. On the grass, 29·2° at Hodsock on the 10th, 31·4° at Strelley on the 27th, and 34·2° at Loughborough on the 11th. The rainfall was above the average, but varied considerably over different districts. At Hodsock the total value was 3·65 inches, at Loughborough and Strelley 3·00 inches, at Henley-in-Arden 2·72 inches, and at Coston Rectory 1·85 inches. The latter station is about twenty miles east from Loughborough, and the difference in the amounts is rather remarkable. The heaviest falls were on the 6th, 7th, and 8th, which contributed above 2 inches of the total. The entire absence of thunder storms is a feature of the month. Sunshine was above the average. Solar halos were observed at Loughborough on the 10th and 11th.

Wm. Berridge, F. R. Met. Soc.

12, Victoria Street, Loughborough.

Natural History Note.

An Interesting Section, which ought perhaps to be noted, is exposed in a road cutting, over which is carried the Charnwood Forest Railway, at Hugglescote, and near to Bardon Hill. This section—in obtaining which I had the kind assistance of Mr. E. F. Bates—is about 350 feet in length, and is as follows:—Northern drift, rising from 4 feet to 10 feet, containing large blocks of banded slate and volcanic ash, &c., derived from rocks in the immediate vicinity, of various sizes, varying from 29 inches by 18 inches downwards. This rests on, in a conformable manner—so far as exposed, but is very probably thicker—about 5 feet of conglomerate, containing well-rounded and subangular pebbles of banded slate, volcanic ash, quartz and quartzite, millstone grit, carboniferous limestone, fibrous gypsum, chalk and flint, hæmatite ironstone nodules, worn specimens of *Gryphea arcuata*, and small pockets of soft sand. The matrix is a carbonate of lime, which is soon decomposed by weathering, leaving the pebbles rather loose on the surface. This conglomerate is very probably the representative of the gravels of glacial age (Eastern Drift) exposed in other parts of the county, and has been cemented together by the decomposition of the chalk and limestone pebbles it once contained.—H. E. Quilter, Leicester.

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Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Geological Section, June 30th.—T. H. Waller, Esq., in the chair. The Chairman of the Section accepted, with thanks, on behalf of the society, from Dr. Callaway, D.Sc., F.R.S., two pamphlets, 1. On Comparative Lithology; 2. On the Granite and Schistose Rocks of Northern Donegal. Exhibits:—1. A fine specimen of fossil wood from the Isle of Portland; 2. By Mr. Robinson, a tiger lily, in which several stems had grown together into one flat stem; 3. By Mr. W. H. Wilkinson, a very interesting specimen of an abnormal development of the White Foxglove (*Digitalis purpurea* v. *alba*), in which the terminal flower was formed by the union of 3¼ ordinary blossoms united together, forming a large lily-like bloom of 3in. diameter and 2¼in. deep, from a garden at Acocks Green; 4. By Miss Taunton, *Asarum Europæum*, from Ludlow (originally from woods in Herefordshire); 5. By Mr. Bolton, *Argulus coregoni*, found in the canal, near Birmingham (it is a European species, and was found in 1883, in the Royal Aquarium, at Westminster, but its source was not known); 6. By Mr. Udall, Rock specimens from Malvern and Foxyards. Sociological Section, June 25th.—Mr. W. R. Hughes, F.L.S., Chairman, in the chair. Mr. C. H. Allison read and expounded the last two chapters, 13 and 14, of the first volume of Mr. Herbert Spencer's "Principles of Biology," viz., "The Co-operation of the Factors" and "The Convergence of the Evidences," and concluded with a paper on the "Appendix." A discussion followed, joined in by the President, Dr. Hiepe, Mr. F. H. Collins, Miss Naden, and others.—General Meeting, July 7th. Mr. W. H. Wilkinson exhibited *Orchis maculata*, *O. latifolia*, *O. pyramidalis*, and the cut-leaved mignonette, *Reseda lutea*, from Broadway, Worcestershire.—Biological Section, July 14th. The following were exhibited: By Mr. W. H. Wilkinson, a fine collection of plants from Scotland, including *Stellaria nemorosa*, *Cerastium arvense*, *Myrrhis odorata*, and *Equisetum sylvaticum;* by Mr. Thomas Clarke, marine alga, *Callithamnion plumula*, showing fructification; Mr. Thomas Bolton, F.R.M.S., *Lacinularia socialis*, from Warwick; *Euglena*, from Harborne, possibly distinct variety; Mr. J. E. Bagnall, A.L.S., *Scapania irrigua*, from Baddesley Ensor, new to the district; *Anisothecium crispum*, var. *elatum*, new record for Warwickshire, from Sutton; for Mr. Fred. Enock, *Pyrola minor;* for Mr. John Humphreys, *Acorus Calamus*, Sweet Flag, in fine fruit, from Hewell Grange; for Miss Taunton, *Asarum europæum*, from Herefordshire; for Mr. R. M. Serjeantson, *Asplenium adiantum-nigrum*, *A. Trichomanes*, *Carduus pratensis*, and other plants, from Bampton, North Devon.—Sociological Section, July 2nd. Chapter Seven of Mr. Herbert Spencer's Study of Sociology on "Subjective Difficulties—Emotional," was read by the hon. sec., Mr. A. Browett. On Saturday, the 4th instant, the fifth excursion of the Section was made to the "Country of William Shenstone," under the leadership of Mr. W. Howell Rogers, M.A., LL.M. The party left Mason College at two o'clock, in a four-horse break, and drove first to the Leasowes, the birth-place and almost life-long residence of Shenstone, and where he died. After inspecting the interesting old place and wandering through its shady groves, they proceeded to St. Kenelm's Chapel at the foot of Clent Hills, where Mr. Rogers delivered a short address. They then returned to Belle Vue, Halesowen, at the invitation of E. Gem, Esq., J.P., where they were most hospitably and sumptuously entertained by him. Mr. Rogers then read an able and eloquent paper

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on "Shenstone's Life and Works." After the customary votes of thanks, and a pleasant stroll in Mr. Gem's grounds, the party returned to Birmingham, bringing to a close, by about nine o'clock, a most successful and agreeable excursion. GENERAL MEETING, July 21st.—Mr. J. Pumphrey exhibited the Lancashire asphodel (*Narthecium ossifragum*), from the English Lakes; also abnormal specimens of the Canterbury bells (*Campanula Medium*), a purple flower with three perfect corollas one inside the other, and a cluster of white blossoms on a much fasciated stem, the corollas variously united, the numbers of the petals varying from 5 to 17 in each altered flower. Mr. A. W. Haines exhibited a proliferous rose. Mr. W. H. Wilkinson exhibited *Potentilla argentea*, from Hagley, rare. Mr. W. P. Marshall (who was heartily welcomed back after his tour in America) gave some interesting accounts of his Natural History researches while in that country, and amongst the many interesting specimens he exhibited were the following:— Stem of verillia, 6½ feet long, from Puget Sound, California, presented by the Californian Academy of Science, as also a copy of their "Proceedings"; Specimen of water, from the Great Salt Lake, Utah; an entomostracon (*Artemisia salina*), from the Great Salt Lake; blind cray fish, from the Mammoth Cave, Kentucky; also a blind insect, allied to the grasshoppers, but not yet known to have been described; swallow-tail butterfly (*Papilio rutulus*), from Yosemite Valley, and from Sierra Madre, California; also a butterfly from Niagara; dragon flies, from the Yosemite and Chicago; and three grasshoppers, from the Great Salt Lake. Also the following plants:—*Plantago officinalis* (?), plantain grass, 3 feet high; *Urtica dioœca* (?), stinging nettle, 8 feet high, stem ¾in. diameter; *Sequoia gigantea*, Californian Big Trees; wood and bark, Mariposa; snow flower, Yosemite Valley Road; cypress, from Montereyl, California; original American cypress; oak galls, &c., with larvæ suspended by threads radially inside gall; *Chlorea vulupina*, lichen, from Big Trees in Mariposa Grove. The whole of his explanations and descriptions were listened to with great attention, and the various specimens were much admired. Mr. Marshall promised to exhibit the remainder of his specimens, including geological ones, at the meeting next Tuesday.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—June 22nd. The President, Mr. C. Beale, in the chair. Mr. J. W. Neville exhibited specimens of copper and silver ores from Caldera, South America; Mr. Hawkes, the following fungi:—*Puccinia syngenesiarum*, *P. malvacearum*, *Urocystis pompholygodes*, and *Uredo miniata*, the latter an early stage of the Burnet Brand; Mr. Madison, specimen of travertine from the oolite of the Cotswold Hills. Under the microscope, Mr. Tylar showed a section of reconsolidated basalt from the Cakemore Brickworks, Rowley, also teeth of eel. Mr. Hawkes then read a paper on "The Flora of a Country Lane," in which he pointed out the fortunate situation of our great town in a rich and beautiful country, where botanists need never despair of finding abundant fields of labour. The lane selected leads from Minworth Green to Water Orton. The paper, which only dealt with the flowering plants, described the district as one yielding both heath and marsh plants, the latter mostly predominating owing to the lacustrine origin of the district. Lists were given of the more striking botanical features, and the paper concluded by regretting the necessity for the encroachments of the sewage farm. The paper was illustrated by freshly gathered and mounted specimens.—June

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29th. Mr. Deakin exhibited the nest and eggs of the golden-crested wren, *Regulus cristatus*, taken near Kingswood; Mr. Madison, specimens of *Paludina vivipara* and its variety *unicolor;* Mr. Hawkes, the following fungi:—*Trichobasis cichoracearum*, *T. rubigo-vera*, and *Ustilago antherarum*, the latter on the anthers of *Lychnis vespertina*. Under the microscope, Mr. Hawkes showed a section of coltsfoot leaf through cluster-cups and spermogones; Mr. J. W. Neville, palate of octopus. —July 6th. Mr. Madison exhibited specimens of *Helix arbustorum*, from near Cheltenham, showing interesting variations; Mr. Hawkes, *Æcidium epilobii* and *Trichobasis caricina;* Mr. Sanderson, a collection of plants from Chapel-le-Dale, including *Primula farinosa*, *Gymnadenia conopsea*, the fragrant orchis, *Paris quadrifolia*, and wood betony infested with *Puccinia betonicæ*. Under the microscope, Mr. Tylar showed a section of iron furnace slag; Mr. Hawkes, a section of leaf of burnet, showing brand *in situ* on uredo spores. Mr. J. W. Neville read a paper on practical microscopy—"Insects' Mouths: how to Dissect and Mount them," which described the various types of insects' mouths and the best manner of dissecting them to show their peculiar features, and the difficulty of dissecting some on account of their smallness. Several objects were dissected, and the process of manipulation shown, through carbolic acid into balsam, and afterwards exhibited.—July 13th. Mr. Hawkes exhibited specimens of the following fungi:—*Uromyces intrusa* and *Aregma obtusatum;* Mr. Insley, specimens of the fossil fruit of a coal plant, and some of the rarer marine shells of the coal period in this district, comprising specimens of lingula, productus, euomphalus, and orthoceras; Mr. Madison, large specimens of *Limnæa auricularia*, from Earlswood. Under the microscope, Mr. Dunn showed a social rotifer, *Lacinularia socialis;* Mr. Hawkes, a section of strawberry leaf through its rust and brand. Mr. Betteridge presented to the Society a second instalment of birds prepared for the cabinet in further illustration of his series of papers on "The Birds of the District;" it consisted of sixteen specimens, mostly summer visitors, and included the wood warbler, *Sylvia sibilatrix;* nightingale, *Philomela luscinia;* and grasshopper warbler, *Salicaria locustella*.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —Section D.—Zoology and Botany.—Chairman, F. T. Mott, F.R.G.S. —Monthly Meeting, Wednesday, July 15th. Attendance, seven (three ladies). The Chairman reported that at the field day on the previous Wednesday, five members went to Narborough Station, walked along an interesting lane to Enderby, visited the old granite quarry, and returned to Narborough. Search was made at the quarry for several rare plants reported to have been found there in past times, but without success. They are probably extinct. The following objects were exhibited:—By Dr. Cooper, specimens of the grasses *Festuca gigantea*, *elatior* and *loliacea*; by Mr. E. F. Cooper, F.L.S., a growing specimen of *Aspidium lonchitis*, from Scotland, and dried specimens of *Lepidium campestre* and *Smithii*, showing the small differences by which they are distinguished; by the Chairman, a specimen of the Common Bat, *Vespertilio pipistrellus*, and several unusual garden flowers. Mr. W. W. Vincent, of Houghton House, Stonygate, was elected a member of the Section. The Chairman apologised for not being prepared to read the paper announced, on "Mr. John Plant's Catalogue of Leicestershire Mollusca." It required more time than he had expected to put the catalogue into modern form, but he hoped to have it ready for the next meeting.

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NIAGARA

AND ITS PHYSICAL AND GEOLOGICAL CONDITIONS.*

BY W. P. MARSHALL, M.I.C.E.

The great Niagara Falls are the most remarkable in the world on account of their enormous volume of water; they are exceeded in height two, three, and more times by other great falls, but far exceed them in the mass of water flowing over the falls. Niagara is the sole outlet of four out of the five great lakes or inland seas that divide the United States from Canada, and form the drainage of the enormous extent of country surrounding them; the largest of these lakes is more than 400 miles in length and 100 miles in width, and the whole together are as large in area as Great Britain.

The Niagara Falls have been known for two centuries, having been first described by a traveller, Father Hennepin, in 1678, who has fortunately left an effective sketch of the appearance of the Falls at that time; and a comparison of this sketch with the present condition of the Falls gives very interesting information about important changes that have taken place during the last two centuries. The Niagara River, in the middle of which the Falls are situated, forms the connection between Lakes Erie and Ontario, and the entire discharge from the four upper lakes, Erie, Huron, Michigan, and Superior, passes through the Niagara River into Lake Ontario, and thence by the River St. Lawrence into the Atlantic Ocean below Quebec. The Niagara River is about thirty miles in length, and falls 330 feet in its whole course, one half of the total fall or 160 feet being in the great Niagara Falls.

The first portion of the river from Lake Erie is divided into two channels, which unite above the Falls in a quiet stream nearly two miles wide; this becomes contracted to three-quarters of a mile in width at the Horse-shoe Rapids immediately above the Falls, where the stream rushes down a steep rocky descent, and falls as much as fifty feet in the length of a mile, before reaching the precipice of 160 feet in height that forms the great cataract of Niagara. The water is very deep at the foot of the cataract, and 180 feet in depth at three quarters of a mile distance; and the force of the falling water is so much absorbed in that great depth

* Transactions of the Birmingham Natural History and Microscopical Society. Read February 24th, 1885.

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of water into which it falls, and the velocity of the current is so much reduced, that the disturbance of the surface is but little felt at three-quarters of a mile distance from the foot of the fall, and a small ferry boat is able to cross safely at that point from bank to bank. When in the middle of the stream this ferry boat affords the opportunity of a remarkably grand and comprehensive view of the entire cataract.

The entire width of the water in the cataract is about three-quarters of a mile, but the stream below rapidly narrows to less then a quarter of a mile, and then enters a steep contracted descent, where it falls 100 feet in a distance of seven miles. The greater portion of this fall is in the first two miles, where the stream is narrowed to only 220 feet width, forming the Whirlpool Rapids; the violent rush of the enormous mass of water through this contracted gorge, which is only one-fifteenth of the original width at the edge of the cataract, causes great surface-waves that dash together and throw up spray to a height of twenty and thirty feet. The direction of the stream is then suddenly turned nearly at a right angle, forming a great eddy at the bend, which is the celebrated Whirlpool. During the whole of this seven miles course below the cataract, the stream is confined between steep lofty cliffs 200 feet in height above the water; but these cease suddenly at Queenston, and the remainder of the course is a quiet open stream on to Lake Ontario.

The cataract is divided into two unequal portions by a large island, Goat Island, of about a quarter of a mile in width, and three-quarters of a mile in length, standing between them; the larger cataract is the Horse-shoe or Canadian Fall, which is nearly half a mile width along the curved edge of the fall, and the American Fall on the other side of Goat Island is nearly a quarter of a mile in width. In addition, there is the small Centre Fall, about 70 feet in width, separated by a small rocky island, Luna Island, from the American Fall. The greatest depth of water in the falling stream is in the centre of the great Horse-shoe Fall, and the thickness of the stream at the edge is as much as twenty feet at that part; in the other falls the thickness of the sheet of water is probably from two-thirds to one-third of that amount. A trial of the depth of water over the Horse-shoe Fall was once made by allowing an old ship to be carried over it, which drew eighteen feet of water (the "Michigan" in 1827), and was found to pass over clear.

In these Falls there is an open space forming a cave excavated behind the cataract and extending, probably, the entire length of each fall. This arises from the

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circumstance that although the upper half of the face of the precipice over which the water falls is composed of hard limestone rock, the lower half is soft shale, which is being continually eaten into and crumbled away by the action of the spray from the cataract; this causes a cave to be excavated that extends to forty feet depth, and gradually undermines the upper rock, which breaks away when unsupported. The cave can be entered at each extremity of the great falls, by passing behind the sheet of falling water; but this can only be done for a short distance on account of the extreme violence of the gusts of wind and spray. In the small centre fall, however, there is the means of passing completely through the cave behind the fall, which is called the "Cave of the Winds," and the visitor, after getting through, returns outside in front of the fall over an accumulation of fallen rocks that have broken away at former times from the face of the rock above. Access is obtained by means of spiral stairs down the face of the rock on Goat Island, and the visitor has to prepare for the purpose by a complete change of clothing to a thick woollen bathing dress with an oilskin overcoat and hood. Goat Island is reached from the shore by a bridge over the stream of the American Fall, crossing a small island that stands in the middle of the stream. On the opposite side of Goat Island there is also a bridge reaching on to the Terrapin Rock, which is in the Horse-shoe Fall, standing on the edge of the fall, and which affords a grand view of the great cataract. At the upper end of Goat Island there are three small islands, "The Three Sisters," connected by bridges, and reaching out one beyond another into the Upper Rapids, of which a striking view is obtained from these islands.

An effective practical illustration of the mass of water in the Niagara Falls may be obtained from the dimensions of the Birmingham Town Hall. Imagine a sheet of water descending in front of the organ and extending in width all across from wall to wall, with a thickness of stream as much as the projection of the side galleries, but the height of the fall nearly three times as great as the height of the hall from floor to ceiling. This will represent the small centre fall, behind which the visitor passes through the "Cave of the Winds," returning in front over the rocks at the foot of the fall, and standing there looking up at the mighty mass of water rushing headlong down close in front. Then imagine this great sheet of falling water extended to a continuous width of nearly half a mile, and increased in thickness to twenty feet, and that will represent the great Horse-shoe Fall.

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On the American shore the Cataract House Hotel stands on the edge overlooking the Upper Rapids, and the most satisfactory course for seeing the Niagara Falls is to commence from that point, going direct on to Goat Island and to the Terrapin Rock for a close sight of the Horse-shoe Fall, and on to Luna Island for the American Fall, and to the "Three Sisters Islands" for the Horse-shoe Rapids; then descend the stairs to go through the "Cave of the Winds." Next see the other side of the American Fall from the shore, descend to see the fall from the rocks at the bottom, and cross over by the ferry, getting the view of both falls from the middle of the river; then see the Horse-shoe Fall from the Canadian side, and the view of the whole from the Suspension Bridge which crosses the river at a quarter-of-a-mile below the American Fall. The general views of the whole Falls are better appreciated after having had the opportunity of seeing the cataract from a close point of view, both at the top and from below, in order to realise the enormous magnitude of the mass of falling water; the sense of which is dwarfed in effect when seen first as a whole from a distance, on account of the very great width (nearly three-quarters of a mile) over which the Falls extend. The enormous mass of spray that is thrown up by the cataract forms a remarkably striking feature, floating in front of the Falls like a gauze veil that is continually changing in form and position; and in the case of the great Horse-shoe Fall this cloud of spray rises up in the air sometimes to three times the height of the Falls. The rainbows that are so numerous and brilliant in the spray make a lovely picture.

In consequence of the continued wearing away of the shale strata behind the cataract, and the breaking down of the overhanging limestone rock, the whole face line of the Falls is subjected to a gradual displacement, shifting it backwards up the stream with a certain, though very slow, movement; and the result has been a definite change in the position of the cataract during the time it has been known, and even within the memory of present visitors (in 1850) a large mass of rock at the outer extremity of the Horse-shoe Fall has broken away and fallen to the bottom of the cliff. This mass, called the "Table Rock," was completely undermined, and projecting over the stream below the Falls, standing out in front of the cataract and affording a very fine point of view; it fell suddenly, without previous warning, and a man upon it at the moment had only just time to escape. It appears from Hennepin's sketch, made two centuries ago, that at that time this Table Rock formed an island at the edge of the cataract, like the Terrapin Rock at the present time at the

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other extremity of the same fall, and a portion of the stream passed behind the island and formed a separate small fall at right angles to the main Falls. It is known also that at the present time the centre portion of the Horse-shoe Fall has become more deeply indented than formerly, modifying the previous horse-shoe form that originated the name of the fall.

On considering the whole circumstances, the conclusion seems irresistible that the Horse-shoe Fall has gradually cut its way all across the front of Goat Island from the end of the American Fall to its present position, and that the American Fall has not materially changed during that time, except in getting partially indented in the centre and somewhat horse-shoe in form, from the same cause that has given its form to the Horse-shoe Fall, namely the greater depth and force of current in the middle of the stream than at the sides. Further, the conclusion seems irresistible that the same cutting away action had previously carried the Horse-shoe Fall all across the face of the present American Fall, forming in its course the precipice over which that now falls; and that in still earlier times the Horse-shoe Fall had similarly cut its way all through the seven miles of the present gorge from the face of the cliffs at Queenston, where the cataract must have commenced. The progress during the last two centuries is estimated at about a foot per year; but as regards the future progress of Niagara, it has to be noticed that when the Falls have receded another mile, they will have reached the open space behind Goat Island, and at a second mile distance the river is nearly two miles wide, so that the fall will be then three times the total width of the present Falls, and the thickness of the sheet of water proportionately less. The consequence of this will be a proportionate reduction in the wearing action of the water, and in the rate of the receding of the fall. This rate will be also further reduced by the circumstance that as the chief breaking down force in action in cutting back the present Falls arises from the perishing of the supporting shale under the top limestone rock, causing this rock to be undermined and break off in masses, and these strata are not horizontal but dip backwards, at an inclination of about twenty-five feet per mile, when a distance of about three miles back has been reached, this cause will have ceased from the cropping out of the strata.

Some other circumstances will thus intervene to affect the result, complicating the question and making it a very interesting one for consideration. The height of fall of the

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cataract will be increased by the addition of the fifty feet that the stream now falls in passing the upper rapids. The excavation of the new receding channel may not extend across the entire two miles width of the river, and may probably be limited to a central portion of greatest depth and force of current; in that case the American Fall on the opposite side of Goat Island from the new excavated channel may be expected to be run dry, and to show only a bare precipice in place of the present cataract, and the "Cave of the Winds," though still a cave, would lose both its water and winds. When the cataract recedes still further to the point where the stream divides into two channels it will depend upon the force of current and the nature of the bottom in each whether the cataract recedes along both streams equally or not.

The volume of water that is constantly rushing over the Niagara Falls has been estimated at about a million cubic feet per second, or about six million gallons per second. An idea of this quantity of water can be formed from the size of the Birmingham Town Hall; imagine the interior of the hall entirely cleared from galleries and orchestra, leaving the bare external walls, then this quantity of water would fill it from floor to ceiling twice over every second. Some idea of the probable correctness of the estimated discharge of a million cubic feet per second may be readily formed from the following general dimensions:—2100 feet width for the Horse-shoe Fall, 1100 feet width for the American Fall, and 70 feet for the Centre Fall; and then taking twenty feet for the thickness of the stream of water at the Horse-shoe Fall, and assuming two-thirds that depth at the American Fall, and one-third at the Centre Fall, a total sectional area of about 60,000 square feet is obtained for the stream of water at the edge of the Falls; then this area of stream with a velocity taken at twelve miles an hour, or eighteen feet per second, gives a discharge of about a million cubic feet per second. At the ferry below the foot of the Falls, where the depth of water is 180 feet, and the width about a quarter of a mile, the same quantity of water per second gives a current running at only about two and a half miles an hour, and slow enough to allow of being crossed by a small rowing boat.

In an interesting paper on Niagara Falls which was given at the recent Montreal Meeting of the British Association, it was pointed out that the peculiar conditions that are present there, namely a hard stratum forming the upper part of the precipice over which the cataract falls, with a soft stratum forming the lower portion that is continually being caved out,

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leaving the projecting hard rock at the top, is really the essential condition requisite for the formation of all *cataracts;* and when the face of the precipice is uniform in hardness from top to bottom the inevitable result of wear is a gradual uniform slope forming a *rapid* and not a *cataract.* The hard rock stratum of Niagara Falls crops out upon the face of the Queenston Cliff, where it is twenty-five feet in thickness and 250 feet in height from the water; and it follows that in the origin of these Falls they were nearly 100 feet greater in total height than at the present time, and had the same cataract form in the upper portion, but probably the form of a rapid in the lower portion on account of the soft stratum not extending completely to the bottom; also that in the future of these Falls the present cataract character will ultimately become lost, and the whole be reduced to a rapid.

THE FIRST DISCOVERY OF THE CHOLERA BACILLUS.*

BY FRANCIS FOWKE, F.R.M.S.

During the outbreak of cholera, in 1849, a sub-committee of the Bristol Medico-Chirurgical Society was appointed to investigate the nature of cholera by means of microscopical observations. Two of the sub-committee, Drs. Brittan and Swayne, each separately examined the rice water evacuations, which had been obtained from two patients in the cholera hospital, with microscopical objectives of $^1/_8{}^{th}$ and $^1/_{12}{}^{th}$, by Powell and Lealand, and Ross, respectively, and they describe as follows, the cells, annular bodies, or corpuscles, which they observed:—"They vary very much in size and apparent structure during the different stages of their development. The smallest are of the same size as, or even much less than, blood-globules, so that to show them properly an object-glass of high magnifying power, such as one-eighth, one-twelfth, or one-sixteenth of an inch is required; their walls refract light powerfully; fragments of them present the appearance of *small segments of circles.*" The italics are mine. Dr. Budd found identical bodies in drinking water, obtained from cholera districts, and Dr. Brittan also from the air of infected places.

* Abstract of paper read before the Birmingham Natural History and Microscopical Society, May 19th, 1885.

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Dr. Koch thus describes the cholera bacillus in his reports on the cause of the cholera-epidemic, presented to the German Government, as the result of investigations on the excreta, and on the dead bodies themselves, of cholera patients in Egypt and in India. The internal organs, lungs, liver, spleen, kidneys, etc., as well as the ejecta, were found to swarm with microbia of a great variety of kinds; in all cases was found one definite kind of bacillus. This was found in largest quantities in the tubular glands of the intestines, especially between the epithelium and the membrane of the gland. This particular form was also never found in the intestines or in the ejecta of those not suffering from cholera.

The cholera bacillus is not quite straight, but is somewhat curved, in the manner of a comma, or even nearly semi-circular. In cultivation, there often arise S-shaped figures, and shorter or longer slightly wavy lines.

As to the question whether their presence is simply due to the presence of the choleraic disease, which promotes their growth and development, or whether they are themselves the cause of cholera, Dr. Koch is very strongly of opinion that the latter is the true explanation, since they are never found either in the organs or the ejecta except in the case of patients who have died of, or are suffering from, cholera. They are also found in that organ which is the seat of the disease, namely, the intestines; in the first feculent ejecta, the bacilli occur only in small quantities, while in the liquid odourless ejecta they occur in enormous quantities, all other kinds of bacteria being almost entirely absent; they diminish in number as the excreta become more feculent, and have entirely disappeared when the patient is completely restored to health.

If this description is compared with that of Drs. Brittan and Swayne, who examined upwards of sixty cases, there is a remarkable resemblance. Dr. Brittan found some peculiar corpuscles to be constant in the intestinal discharges of cholera patients; and similar bodies, but smaller, though well defined, were discovered by him in the matters vomited; they appeared larger and more compound in the dejections; decreased as the disease progressed favourably; and vanished with the disappearance of the symptoms. Dr. Brittan afterwards examined, under the microscope, specimens of healthy fæcal matter, and the fluid stools of typhus, typhoid, and other diseases; but failed to detect anything corresponding with the peculiar corpuscles belonging to cholera dejections, though he discovered these bodies in cases of severe choleraic

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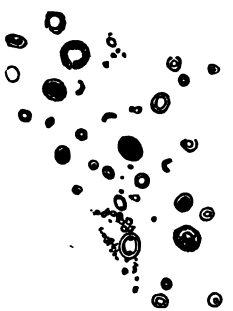
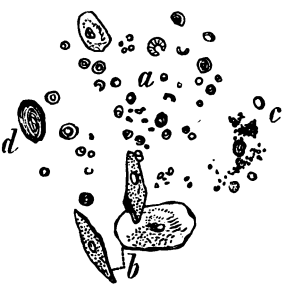
diarrhœa. From these observations, he inferred that the bodies in question were peculiar to cholera, and bore some essential relation to the disease.

For comparison are appended some of the figures by Drs. Brittan and Swayne, and others which have been very kindly lent me by Dr. Klein, which illustrate the chapters on cholera in the new edition of his work on "Micro-organisms." It is Dr. Klein's * view that the bacillus forms rings and splits off, forming the cholera bacillus of Koch, which is also known as the "Comma Bacillus," and is a segment of a circle, as described by Drs. Brittan and Swayne. After carefully comparing the evidence of the description and the woodcuts, I venture to claim for Drs. Brittan and Swayne the priority of the discovery of the cholera bacillus. Then, as now, the discovery received great opposition, a sub-committee of the College of Physicians was appointed, who reported against it, but with insufficient evidence to overthrow the demonstrations.

My reasons for bringing forward this page of forgotten history in the study of the disease of cholera, is not only the interest attached to the way in which the question of the fungoid character of the disease was medically and publicly discussed in 1849, but principally to show, as far as can be now ascertained from the above report, that the comma-bacillus was known and recognised so far back as thirty-five years since, the discovery being made by two Englishmen, Drs. Brittan and Swayne.



Drs. Brittan and Swayne's illustrations of cholera bodies from vomited matter, showing rings. Magnification not stated, but drawn under Powell and Lealand, $^1/_{12}$th objective.



Cholera-cells in vomited matter, from Case 5 (first series). *a*, Cholera-cells; *b*, Squamous and columnar epithelium; *c*, Round, clear, oily globules; *d*, Starch-grain. Magnified 420 diameters. Dr. Swayne.

* See also Dr. Watson Cheyne, *Brit. Med. Journal*, No. 1270, May 2nd, 1885, page 878, fig. 6.

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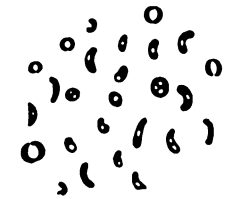

Dr. Klein's illustration, showing rings. Magnified about 700 diameters.

Dr. Klein.

Dr. Swayne.

For further details see *British Medical Journal* of March 21st, page 589.

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

PART I.

(Continued from page 213.)

Description of Beds in the "Spinatus" Zone.

I have found it more difficult to correlate the beds of the "*Spinatus*" *Zone* than those of the "*Margaritatus*," because there are very few sections in which the beds just below the rock-bed can be seen, and these few are long distances apart. It is possible that the rock-bed ("B") is the sole representative of the "*Spinatus*" *Zone* in one or two places.

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Bed "E."

This bed has been placed as the lowest of the "*Spinatus*" *Zone*, not so much for the fossils it contains as for those it does not. It appears to be a marly, micaceous clay, very sandy in some places, and containing concretionary ferruginous nodules, which latter, like the bed itself, are rather unfossiliferous. The thickness at Byfield is 2ft. 7in.; but what I regard as the same bed is about 7ft. or more at Badby, and more than 13ft. at Watford. Exposures of the bed are uncommon, and fossils seem rare, so that I can give no useful list.

Bed "D."

This is a ferruginous, sandy limestone, very shaly at Byfield and Watford, more compact at Badby and near Northampton, but in all these places abounding in fossils. It is only 4in. thick at Byfield, but is 2ft. 3in. at Watford, and 3ft. to 4ft. at Badby. I believe this bed in several places immediately underlies the rock-bed, forming with it only one mass of stone, the usual intervening bed of clay being absent.

Fossils:

Ammonites margaritatus (rare)	Watford, Milton.
Belemnites paxillosus	Watford.
Belemnites	Watford, Badby, Milton.
Cryptænia consobrina	Badby.
Pleurotomaria heliciformis	Watford.
Ostrea cymbium (abundant)	Badby, Watford, Byfield.
Ostrea sportella	Watford.
Pecten liasinus (abundant)	Byfield, Badby, Watford, Milton.
Pecten textorius	Badby.
Pecten æquivalvis	Watford, Badby.
Limea acuticosta	Byfield, Watford, Milton.
Leda (*sp.* ?)	Milton.
Astarte striato-sulcata	Badby.
Protocardium truncatum (abundant)	Byfield, Badby, Watford, Milton.
Cardinia antiqua	Badby, Watford, Milton.
Tancredia (*sp.* ?)	Watford.
Pholadomya ambigua	Badby.
Pleuromya costata	Badby.
Terebratula punctata	Badby, Milton.
Rhynchonella tetrahedra	Badby.
Pentacrinus (*sp.* ?)	Badby.
Cidaris (spine)	Milton.
Serpulæ	Watford.

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Bed "C."

It is even more uncommon to find this bed exposed than "E," and I cannot point to a single place in the county where it can be now seen. There was a pretty good section of it near to Byfield, when the East and West Junction Railway was being made, and Mr. E. A. Walford, F.G.S., has described it* as a marly clay, containing concretionary ferruginous nodules, having a thickness of 1ft. 6in. No doubt this and two or three of the lower beds are what can be seen at Market Harboro', near to the railway station.

Bed "B."

The Rock-Bed.

This is undoubtedly the most important bed of the Middle Lias. Its usual character is that of a hard, calcareous, and ferruginous rock, varying in colour from a bluish green to a reddish brown, according to the amount of weathering it has experienced. The change in colour is due to a change in the condition of the iron present in it. The rock is often sufficiently hard and compact to form a good building stone, and many villages have been built of it, but of late it has been almost entirely superseded by bricks for such purposes; in like manner it has been replaced by slag and Hartshill stone for public road-making, though it is still used at times for private roads and sometimes of course for building.

The rock is also at times sufficiently ferruginous to be worked as an ironstone, the calcareous matter present being considered an advantage by acting as a flux.

It is sometimes so sandy that it can scarcely be distinguished from the Northampton sand by its mineralogical characters only; this is the case around Byfield. Fossils are exceedingly abundant, and it is common to find bands made up almost entirely of *ossicles and fragments of shells*, or of shells of *Rhynchonellæ*, or less commonly of *Terebratulæ*. Usually the fossils contain beautifully crystallized calcspar, though where the bed is very sandy the fossils are only casts. *Large Belemnites* are common, and serve to distinguish it from the Northampton sand, in which few are found.

In the lower part of the bed flattened nodules or concretions of argillaceous limestone are at times met with; they are rather abundant at Bugbrook.

* "On some Middle and Upper Lias Beds in the Neighbourhood of Banbury," by Edwin A. Walford.

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The rock-bed is the great water-bearing bed of the county to the West and South-west of Northampton, and there are probably some hundreds of springs and wells in it used for domestic purposes. The making of wells has facilitated the examination of the rock in districts where it does not come to the surface. As I propose to devote a section entirely to the consideration of the water-bearing capabilities of this bed, it is not necessary for me to do more here than call attention to the remarkable uniformity of this characteristic of it.

The thickness of the rock-bed varies very little, comparatively, in the west and south-western parts of the county; in most cases it is between 5 and 6 feet, but near Byfield about 11 feet. In the northern parts of the county it gets very thin, and may be absent altogether in some places.

Sections of the rock-bed are numerous, so I have omitted giving the localities of the fossils. A more complete list of the fossils, too, will appear in the section dealing with the Palæontology of the Middle Lias.

Fossils.

Ammonites spinatus.
Ammonites Holandrei.
Belemnites paxillosus, and others.
Cryptæna consobrina.
Eucyclus concinnus.
Pleurotomaria sp. (?)
Actæonina Ilminsterensis.
Ostrea submargaritacea.
Ostrea sportella.
Ostrea cymbium.
Plicatula spinosa.
Pecten æquivalvis.
Pecten liasinus.
Pecten dentatus.
Pecten textorius.
Hinnites Davæi.
Lima punctata.
Lima Hermanni.
Macrodon liasinus.
Astarte striato-sulcata.
Cardinia concinna.
Spiriferina oxygona.
Terebratula punctata.
Terebratula Edwardsi.
Waldheimia indentata.
Waldheimia resupinata.
Rhynchonella tetrahedra.
Rhynchonella tetrahedra, var. *Northamptonensis.*
Serpulæ.
Pentacrinus.

Bed "A."

The Transition Bed.

This bed in Northamptonshire is usually a rather thin band of gray, friable, sandy marl, passing upwards into a red sandy clay. The lower part only is fossiliferous, but that extremely so, though most of the fossils are small. The marl appears to be made up chiefly of rounded calcareous grains; it effervesces considerably with acids, and weathers

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reddish-brown on exposure. This lower portion sometimes passes into a hard and compact limestone, but even then, apart from the fossils it contains, it is easily identified.

The thickness of the bed seldom exceeds six inches, but near to Northampton it reaches fourteen inches.

Considering the thinness of the bed, the number of distinct genera and species of fossils is very large. The characteristic ammonite, *A. acutus* (Tate), is nearly everywhere abundant, and *gasteropods* must have swarmed in the shallow sea in which it was deposited. Most of the fossils of the "*Spinatus*" *Zone* are found in this bed, hence it is usually included in the Middle Lias. *Rhynchonellæ*, *Ammonites*, and *Belemnites* are common, but they are all small, as though the conditions were unsuitable to their proper development. *Serpulæ* are rather abundant, and of large size.

The list of fossils given below is by no means a complete one, but only a list of such as can be found in most places, where the bed is developed, and since these places are rather numerous I have omitted giving the localities from which the fossils have been obtained, as in the case of the rock-bed.

FOSSILS:—

Ammonites acutus.
Ammonites Holandrei.
Belemnites.
Cerithium ferreum.
Cerithium liassicum.
Chemnitzia foveolata.
Chemnitzia semitecta.
Eucyclus Gaudryanus.
Phasianella turbinata.
Turbo linctus.
Trochus lineatus.
Cryptænia consobrina.
Cryptænia expansa.
Actæonina Ilminsterensis.
Pecten textorius.
Pecten æquivalvis.
Pecten liasinus.
Cucullæa Münsteri.
Astarte Voltzii.
Astarte striato-sulcata.
Cardinia philea.
Ceromya (Venus) bombax.
Rhynchonella tetrahedra.
Rhynchonella tetrahedra, var. *Northamptonensis.*
Ditrypa etalensis.
Ditrypa circinata.

CONDITIONS OF DEPOSIT OF THE MIDDLE LIAS.

That the various members of the Lias—Lower, Middle, and Upper—are conformable one with the other is generally admitted; there is no great break in the succession of life at any part of the series, although considerable changes occur in the nature of the sediment.

From the lithological characters of the part of the Lias we have been considering *(ferruginous limestones and sandy clays containing concretionary ferruginous nodules)* as well as

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from the fossil contents of the upper beds, I think there was a shallowing of the seas taking place in this district from actual elevation of the sea-bed. The sandy nature of the beds, the large amount of iron often found in the rock-bed, and the common occurrence of wood in the same, may, I think, be taken as indications of nearer, and, therefore, recently formed land. This gradual elevation continued probably till some part of the rock-bed protruded from the water, and suffered the erosion which it exhibits in a few places; other portions meanwhile remained still under water, and received the shallow water deposits which we have called the Transition Bed.

Professor Judd ("Geology of Rutland," p. 65) observes that "When the junction of the Upper Lias with the Marlstone Rock-bed is seen, the latter often presents the appearance of having suffered erosion before the deposition of the latter;" and also "Taking into account all the characters presented by the Marlstone Rock-bed, and remembering the evidence of shallow water conditions which the beds immediately lying upon it exhibit, it seems probable that an interval occurred between the deposition of the Marlstone and the Upper Lias; but when we remember the fact of the passage of certain species from one to the other, especially of the Planulate Ammonites, it is clear this interval was not one of long duration."

Mr. E. A. Walford, F.G.S. ("On some Middle and Upper Lias Beds in the neighbourhood of Banbury") says:—"The shelly band at the top of the rock-bed, at Aston-le-Wall in particular, is made up chiefly of broken and rolled Belemnites, separated valves of Rhynchonellas, and detached Pentacrinite joints, suggesting an interval of cessation in deposition of sedimentary matter prior to the formation of the next layer. One fragment I have of the rock-bed shows an eroded surface in the hollows of which are numbers of valves of *Astarte striato-sulcata* (Romer), for the most part in an upright position, and so packed as to suggest the necessity of a strong current to place them so. The Transition Bed generally at Aston presents evidences of littoral conditions in the worn and fragmentary character of many of the shells."

It is probable that the shallow sea in which the Transition Bed was deposited was not entirely cut off from the deeper sea in which the Upper Lias was developing, because distinctly Upper Lias fossils are found mixed with Middle Lias ones in this bed, though there is a great preponderance of the latter.

(To be continued.)

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ON STARCH.*

BY EDWARD FRANCIS, F.C.S.

The substance of plants is not homogeneous, but is composed of small structures termed cells. Each cell is a whole complete in itself, at least for a time, and is composed of solid, soft, and fluid layers. The formative material which closely lines the walls of the cells, and which is soft and inelastic, was termed by Mohl, in 1846, protoplasm. It is an albuminous matter, and consists of protein compounds, fat, mineral salts, and water. It dissolves in dilute caustic potash, from which solution casein may be separated by acetic acid. This substance is analogous to the fibrin of animals and the gluten of vegetables. The cell wall consists of cellulose, one of the many hydro-carbons. The protoplasm encloses cavities which are filled with a watery fluid termed cell-sap. In all the cells of the higher plants the protoplasm encloses a rounded body, the substance of which is similar to that of the protoplasm itself. This body is the nucleus. By the formation of grains of chlorophyll the protoplasm becomes differentiated into a colourless, homogeneous part, and into smaller distinct green portions imbedded in the former, the grains of chlorophyll. This differentiation may take place in the dark, when yellow grains only are produced; but, on the contrary, the chemical process by which the green colour is produced has a complicated dependence on light. The yellow and orange rays cause the greatest amount of assimilation, and the violet and indigo least.

The assimilation of plants depends upon the decomposition of carbon di-oxide by the chlorophyll of the cells, which process is rendered perceptible by the exhalation of oxygen in volume nearly equal to that of the carbon di-oxide absorbed. The yellow chlorophyll grains formed in the dark are small, but become considerably longer and green on exposure to light. It is only after they have assumed this green colour and under the continued action of light that they form starch, which becomes imbedded in the chlorophyll grains. This change may be represented by the equation—

$$6CO_2 + 5H_2O = C_6H_{10}O_5 + 6O_2.$$

From which it is seen that twelve volumes of carbon dioxide produce twelve of free oxygen gas. When cells whose

* Read before the Nottingham Naturalists' Society, February 3rd, 1885.

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chlorophyll has produced starch under the influence of light are again placed in the dark, the starch is absorbed and disappears completely from the chlorophyll grains. From these facts it appears that the formation of starch is a function of chlorophyll exposed to light, and its disappearance a function of chlorophyll not exposed to light. Kraus found that in plants of Spirogyra which had lost starch after exposure to dark, the formation of that substance in the chlorophyll grains recommenced in five minutes in direct sunlight, and in two hours in diffused daylight.

Starch always appears in an organised form as solid grains having a concentrically stratified structure, which arise at first as minute masses in the protoplasm, and continue to grow while lying on it; their growth stops when they cease to be in contact with the protoplasm and when they have reached the cell-sap. Every grain of starch consists of a hydro-carbon, water, and a small quantity of mineral matter (ash). The hydro-carbon has the same percentage composition as cellulose, to which it bears a strong resemblance. The starch, however, occurs in two forms in each grain: one easily soluble, which yields a fine blue with free iodine in solution (granulose), and the other, which in its composition resembles the cell wall substance (starch-cellulose). These occur together at every point of the grain; if the granulose is extracted the cellulose remains as a skeleton, which shows the structure of the grain, its total weight being only two to six per cent of the whole. Since granulose preponderates, iodine solution colours the whole blue. Starch grains have always more or less rounded forms, and their internal organisation has reference to a centre of formation lying within themselves. The young grains appear to be always spherical, but since their growth is scarcely ever regular, their form changes to ovoid, ovate, rounded polyhedral, &c. Careful microscopical examination shows that each grain has water distributed throughout its organisation; every point contains water as well as cellulose and granulose. Usually the amount of water increases from without inwardly, and attains a maximum at a fixed point. The cohesion and density decrease with the increase of water, as also the index of refraction, on which partly depends the power of perceiving these properties. The outermost and least watery layer is succeeded by a sharply defined watery layer, and so on until the nucleus is reached, which is a very watery part surrounded by a less watery one. Although every layer is disposed around this centre, yet they are not continuously developed around the whole nucleus.

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In small spherical grains this is the case, but when the number of layers increases with growth, they increase in width more rapidly in the direction of the axis of the grain. The growth of starch grains is accomplished exclusively by intussusception, new particles being thrust in between the layers already existing both radially and tangentially, the proportion of water at the particular places being at the same time changed.

Classification of Starches.

The examination of starches by the microscope requires practical study; drawings and descriptions must be used as guides merely. It is not easy to preserve starches mounted as microscopical objects. Glycerine is the best medium. A high magnifying power is not generally required, except for such as rice and pepper. The best powers are $\frac{1}{2}$, $\frac{4}{10}$, and $\frac{1}{4}$, with micrometer eye-piece. The value of the micrometer scale must be of course ascertained by comparing the divisions with those of a stage micrometer graduated in hundredths and thousandths of an inch. In illuminating the object oblique light is best, when the rings are best seen. The polariscope is very useful, as many starches yield black crosses, which are characteristic, *e.g.*, potato. Dr. Muter has arranged the starches in five classes, according to the following characters:—

Class I.—The hilum and concentric rings clearly visible; all the starches oval or ovate. This group includes tous les mois, potato, arrowroot, calumba, orris, galangal, and turmeric.

(1.) Tous les mois or Canna arrowroot. The granules vary from ·0037 to ·00185 inch. In shape they are ovoid when small. The largest are oval, with pointed ends. Hilum annular eccentric; rings incomplete, very fine, narrow; with polarised light the cross is more regular than that of potato starch.

(2.) Arrowroot (Jamaica) from *Maranta arundinacea* granules ovoid, flattened, tending to triangular form in larger and round in smaller, rings visible and numerous, not very marked; size, ·00138 inch.

(3.) Potato (*Solanum tuberosum*). Granules vary in shape and size, some small and circular, others large, ovate, and oyster shaped. Hilum annular, and rings incomplete. In large grains, rings numerous and distinct. Size, ·0027 to ·00148 inch. Eccentricity averages $\frac{1}{3}$.

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Class II.—The concentric rings all but invisible; hilum more or less stellate. To this group belong the starches of bean, pea, maize, lentil, dari, and nutmeg. The nucleus of the Leguminosæ is seen usually as a long, more or less stellate, air-filled black hollow. The rings are rendered visible by treatment with chromic acid. The starches from bean, pea, and lentil are in shape oval, oblong, and almost identical; but pea and bean have stellate hilum, whilst lentil has a long depression. The size of bean starch is ·00135 inch, of pea ·00111 to ·00007 inch, and lentil ·00111 inch.

The starch of maize varies in form, round to polyhedral, and the size is ·00074 inch.

Class III.—Starches having both the concentric rings and hilum invisible in most granules. This important class includes wheat, barley, rye, chestnut, acorn, and a variety derived from medicinal plants, jalap, rhubarb, senega, &c. Wheat starch is extremely variable in size, having from ·00185 to ·00009 inch. The granules are circular, or nearly so, and flattened. Polarised light shows a cross but not well with water as a medium.

Barley granules are fairly uniform in size, ·00073 in., and in form are slightly angular circles. Acorn granules ·00074 in. diameter, and almost round; eccentricity $\frac{1}{4}$. The others call for no special remark, and are distinguished chiefly by measurement.

Class IV.—All the granules truncated at one end. This class includes sago, tapioca, and arum, besides several drugs, viz.:—belladonna, colchicum, scammony, podophyllum, canella, aconite, cassia. Sago starch is found in oval ovate granules, and ·0026 to ·00111 in. in size. There is a curved hilum at the convex end and rings are faint. Tapioca being prepared on hot plates has the starch grains altered from their original shape. They appear in groups of two to eight granules each, showing a little circle with a broad flat zone around it. In form they vary from that of a kettle-drum to a sugar loaf, a conical hollow appearing in the nucleus. Size, ·00074 to ·00055 in. Each granule is truncated in one facet. Arum starch has two facets. The starches from the medicinal plants are similar, but are best distinguished by their measurements.

Class V.—In this class all the granules are angular in form. It includes oats, tacca, rice, and pepper, as well as ipecacuanha. Oat starch is mostly polyhedral, being irregularly three to six-sided and ·00037 in. in size. Rice starch has a starred hilum, visible under a power of $\frac{1}{8}$ to $\frac{1}{12}$

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objective. Measurements, ·0003 to ·0002 inch. Pepper starch is only distinguished from that of rice by its smaller size and uniformity of granule.

Chemistry of Starch.

Starch, chemically speaking, belongs to the carbo-hydrates, sub-class amyloses, and contains carbon, combined with H and O, in the proportion to form water. The carbo-hydrates are divided into three classes—

	Glucoses.	Saccharoses.	Amyloses.
Composition	$C_6 H_{12} O_6$ or $C_{12} (H_2 O)_{12}$	$C_{12} H_{22} O_{11}$ or $C_{12} (H_2 O)_{11}$	$C_6 H_{10} O_5$ or $C_{12} (H_2 O)_{10}$
	Grape Sugar (dextrose) Fruit Sugar	Cane Sugar (saccharose) Milk Sugar (lactose)	Starch Dextrin Inulin Cellulose Gum.

The close connection between starch and the sugars is seen from the above table, and will readily explain how starch is converted by absorption of one molecule of water to form cane sugar and two molecules to form glucose in plants. Glucose readily loses water to re-form starch, which becomes stored up in the plant as reserve material; when starch is acted upon by dilute mineral acids, chloride of zinc, and by certain ferments, diastase, saliva, yeast, &c., it is changed into sugar. In these reactions starch takes up the elements of water, and is resolved into glucose and dextrin.

$$H_2 O + 3 C_6 H_{10} O_5 = \underset{\text{Glucose.}}{C_6 H_{12} O_6} + 2 \underset{\text{Dextrin.}}{C_6 H_{10} O_5}$$

Hence, glucose, when required in considerable quantity, is always prepared from starch. When starch is heated with water near to boiling point, the granules burst and disappear, producing a thick gelatinous mass, slightly opalescent from the shreds of fine membrane—the starch cellulose of the granules. By the addition of large quantities of water the solution may be made to pass through filter paper. It is doubtful whether the starch is really soluble—it is more likely to be merely suspended in a swollen, transparent, insoluble jelly. Again, when gelatinous starch is boiled with a small quantity of hydrochloric, sulphuric, or indeed any acid, it speedily loses its consistency and becomes thin and limpid from having suffered conversion into a soluble gum-like substance called dextrin, having the same percentage composition as starch. If the boiling is carried on for some time a further change is noticed, and dextro-glucose is produced. One of the most interesting changes of starch into glucose is produced by diastase, a peculiar nitrogenised principle found in malt. The gelatinous starch is warmed to

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71°C., and a small portion of malt in tepid water is added; in a few minutes the starch becomes limpid and clear, and glucose may be tested for by Fehling's copper solution.

$$3C_6H_{10}O_5 + H_2O = \underset{\text{Glucose.}}{C_6H_{12}O_6} + \underset{\text{Dextrin.}}{2C_6H_{10}O_5}$$

Starch is insoluble in cold water and alcohol. Lime forms a weak compound with it, and free iodine and bromine combine with it to form coloured compounds. The iodine reaction is always used to show the presence of starch in vegetable tissue, and further it is used very extensively by chemists as an indication of the termination of certain reactions in the quantitative estimation of substances where potassic iodide is reduced.

DEEP BORING NEAR BIRMINGHAM.

A boring which is being executed at King's Heath by Messrs. Le Grand and Sutcliff, of 100, Bunhill Row, London, is of considerable interest as affording a good section of the division of the Triassic strata.

Drift - - - - - -	62 feet.
Red marls - - - - -	160 ,,
Ditto, with gypsum - -	123 ,,
Red and blue marls, with gypsum -	97 ,,

Thus the total depth now reached is 442 feet. In the letter from the firm by whom the boring is being executed (and to whom I am much indebted for the particulars), it is pointed out that the range of the gypsum bands, over a thickness of 220 feet (or rather less when the dip of the strata is taken into account), is somewhat unusual. I shall hope to be able to give particulars of the completion of this boring in another number.

W. J. H.

SOME RECENT OBSERVATIONS ON THE STRUCTURE OF ROWLEY RAG.*

BY T. H. WALLER, B.A., B.SC. LOND.

The microscopical structure of the great mass of basic igneous rock which we locally call Rowley Rag was described by Mr. Allport in the "Quarterly Journal of the Geological Society" for 1874, p. 548, so that on the general subject I

* Transactions of the Birmingham Natural History and Microscopical Society, read before the Meeting March 24th, 1885.

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have no need to say more than that the constituent minerals are augite, a triclinic felspar, olivine and its decomposition products, with apatite, magnetite, and ilmenite subordinate in quantity but almost never failing in any part of the mass.

In a number of thin sections which I have from time to time prepared, I have, however, happened upon a few points of rather special interest relating to the structure of the mass in different parts; points, too, which have been attracting a good share of attention during the last few months as throwing some light on the causes which have brought about the curious changes in mineral character among the products of volcanic action in many districts when this is continued over long periods of time.

In one or two of my specimens there is a distinctly microporphyritic structure to be observed; large felspar crystals are scattered through a ground composed of very small crystals of felspar and augite, with a very large quantity of magnetite disseminated through the mass. This large quantity of magnetite is also found in a specimen from Tansley Hill, near Dudley, where the minute felspar crystals in a few places show most characteristic signs of the mass having been in motion after they were formed. They lie in streams, their lengths being to a good extent parallel to each other, while the grains of augite are of very small dimensions indeed.

There are very curious differences in the texture and composition of portions of the mass even close to each other. In the space of a circle of one inch in diameter, sudden changes from very coarse grain to quite fine may be observed. In some sections there is no trace of olivine, in others it forms a very important part; apatite is usually much more abundant in the coarse-grained parts than anywhere else; augite sometimes occurs in well-defined crystals showing eight-sided sections; sometimes it only fills up the spaces between the long blades of felspar.

I have examined the felspar by Szabo's flame reactions and find that the specimens tried were labradorite, but, of course, this does not exclude the possibility of the presence of other varieties.

Mr. Allport, in the paper mentioned above, describes certain red veins or masses, "evidently contemporaneous," as occurring in the midst of the black stone, and it is to these and certain grey veins which prove to be closely related to the red ones that I particularly wish to call your attention this evening. In a recent visit to the Hailstone Hill quarry I was fortunate enough to obtain specimens of one of these

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grey veins in such a good state of preservation that by both chemical analysis and microscopical examination it was possible to determine with facility and comparative certainty the relation which the veins bear to the mass of the rock. The particular vein which has furnished my specimens was about half an inch thick; it traversed a great detached block of stone, so that the extent of it could not be determined. When a thin slice is examined microscopically it is seen to consist of a network of beautifully clear, apparently quite fresh and unaltered crystals of felspar of much larger size than those which occur in the part of the rock in the immediate neighbourhood of the vein. The angular spaces among these are filled up with a clear colourless substance, which in many parts swarms with brownish dust (as seen with a low power), and is not altogether free from it in any instance. A few crystals of green augite, contrasted with the much browner augite of the normal rock, will also be observed, and a very small quantity of green and brownish fibrous materials, evidently the products of decomposition.

When polarized light is employed the felspar is found to be exclusively in either simple or only singly twinned crystals; the multiple twinning so characteristic of the triclinic felspars is, so far as I have observed, totally wanting. This, however, is not a positive proof as to the nature of the mineral, but the presence of orthoclase is proved by the fact that many crystals will be found on careful search which "extinguish" when their length is parallel to the principal planes of the Nicol prisms, and many of the twinned sections become dark in both halves together when in this position. As to sections which do not fulfil either of these conditions, they may be orthoclase or they may be triclinic. The chemical analysis of the vein also shows such a percentage of potash that from this alone we might have inferred the presence of orthoclase.

The felspar also occurs in the form of extremely slender crystals embedded in the dusty material previously mentioned, and these very fine blades are often slightly curved.

Still using polarized light, we shall find that most of the spaces between the felspars remain quite dark between crossed prisms in all positions; that, therefore, we have to do with a glassy residuary base. In a few places, however, this has a stringy, uneven look, coming near, I presume, to Rosenbusch's microfelsite, and in some others there is a very faint and vague polarization, evidently due in some cases to very fine films of felspar, but in others with a quite decided cryptocrystalline character.

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It is important to notice the difference between this transparent perfectly colourless glass and the dark, almost opaque, glass which has resulted from the rapid cooling of masses of similar composition, and which goes by the name of Tachylyte. For purposes of comparison I have a slide cut from the artificial tachylyte which Messrs. Chance, of Oldbury, produced many years ago by melting and casting in moulds the rock under discussion. The difference is evidently owing to the fact that the oxides of iron to which the colour is due had, when these residual glassy patches solidified, been almost all removed by the previous separation in a crystalline state of magnetite and augite, so that the remainder is quite colourless.

When the dust mentioned above is examined with a high power it is seen that many of the individual specks are very irregularly shaped masses of some brown substance, and in a very few cases I believe there are circular clear bubbles in the inclusion, but the bubbles are immovable. In the description of a "Trachyte Pitchstone" from Cantal, in Central France, quoted from Von Lasaulx in Rosenbusch's "Mikroskopische Physiographie der massigen Gesteine," p. 162, the occurrence of patches of brown glass with bubbles in the midst of the colourless glass of the rock is mentioned as an unusual circumstance.

In the red veins the structure is exactly the same, but the glassy base is replaced by a fibrous radiating mineral, though whether it is an original product of the consolidation of the vein or a result of subsequent alteration of the glass it is not easy to decide.

There are a few brownish grains, of which I do not know the nature. They are slightly dichroic, have bright colours in polarized light even in very thin section, and stand out with the peculiar bold relief which shows a high refractive index. One of them shows one line, apparently a cleavage line, parallel to the sides of the section, and this one extinguishes parallel to the line. In another case the substance fills the angle between two felspar crystals; in another, a minute grain is shut into an augite crystal. The dichroism is not strong enough for mica, nor does the structure seem fibrous enough.

The colourless glass is by no means only found in the veins of which I have been speaking. Some of the slides which are exhibited show considerable quantities among the other constituents of the rock, especially in the parts where the crystals are large, and it appears always to be filled with a fine dust similar to that in the grey veins.

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The analysis of the vein gives very curious and interesting results, which are tabulated below:—

	I.		II.
	Sp. Gr. 2·79		Sp. Gr. 2·58
Silica	48·8	... ...	58·3
Alumina	18·1	... ...	17·9
Ferrous oxide ...	7·2	... ...	3·0
Ferric oxide ...	3·5	... ...	2·5
Lime...	8·4	... ...	2·1
Magnesia	4·9	... ...	1·9
Potash	1·9	... ...	5·9
Soda	3·7	... ...	5·2
Loss at red heat	3·6	... ...	2·7
	100·1		99·5

It should be mentioned that in these analyses the titanic acid is not determined; the silica and the alumina are therefore slightly too high, as the rock contains about two per cent. of titanic acid.

I. Gives the percentage composition of an ordinary specimen of the unaltered "Blue" stone close to the vein.

II. That of the vein in question.

We see, then, that the portions of the melted mass which consolidated last contain nine per cent. more silica, and a very much increased amount and different proportion of alkalis, with, as was to be expected, a lower Sp. Gr.

In a paper read to the Section in October last, and published in the "Naturalist" for January, 1885, I mentioned very similar relations as to composition between the main mass of the rock of Penmaenmawr, in North Wales, and certain grey or white veins, evidently contemporaneous, which occur in it; and the same has been described in the case of the great Cockfield Dyke of the North of England, with regard to the glassy residual base (see Mr. Teall's paper in the "Quarterly Journal of the Geological Society" for May, 1884). In the number of the "Geological Magazine" for March of this year Mr. Teall again shows that the glassy base of the hypersthene andesites of the Cheviots has the chemical composition of a quartz felsite, and contains five per cent. more silica than the general average of the rock.

He also throws out the suggestion that the quartz felsites of the district may possibly be the more acid parts left after the separation of a certain amount of crystals from the andesite magma, the separation having been effected either by the subsidence of the crystals or by the still fluid residuum being squeezed out from among them "as water from a sponge."

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It is at any rate pretty well established that a molten siliceous magma from which crystals are separated in the process of cooling will become progressively richer in silica and alkalis and richer in potash relatively to the soda.

It is quite possible that we have in this phenomenon a hint as to the reason of rocks of progressively more acid character being formed in a given volcanic district, as is so frequently the observed fact. If a lava of medium acidity is being erupted it is conceivable that if the heat by which it has been kept fluid in the interior of the earth is so far reduced as to permit of crystallization taking place, any further eruption may only be able to bring to the surface the more acid, still fluid, residue, and by this means the character of the resulting rock masses would be gradually changed. The succession andesite, trachyte, rhyolite with increasing degrees of acidity is frequent in volcanic regions. In the foregoing remarks I have made use of the paper by Mr. Teall, in the "Geological Magazine" for March, which I have previously quoted, as the question is one of much interest, and I think our Rowley veins have a definite bearing on the subject as showing to what a great extent the differentiation of a cooling magma may proceed.

THE FLORA OF WARWICKSHIRE.

AN ACCOUNT OF THE FLOWERING PLANTS AND FERNS OF THE COUNTY OF WARWICK.

BY JAMES E. BAGNALL, A.L.S.

(Continued from page 235.)

GRAMINA.—*Continued.*

BRACHYPODIUM.

B. sylvaticum, *R. and S. False Wood Brome Grass.*

Native: On hedge banks and in woods. Common. July, August. Area general.

B. pinnatum, *Beauv. Barren False Brome Grass.*

Native: On banks, roadsides, and field borders in calcareous soils. Local and rare. July, August.

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II. (*Festuca pinnata.*) Grafton! Great Alne! *Purt.*, i., 83; near Chesterton! Binton! *Y. and B.* Honington, near Wayland Coppice; Lambcote, *Newb.;* Napton-on-the-Hill; near Birdingbury; Kineton; Compton Verney; near Alveston Pastures; Binton; Temple Grafton; Wixford; Exhall; Red Hill; Drayton; Billesley; lane to Snitterfield from Wilmcote; Morton Bagot.

b. pubescens. Rare.

II. Roadsides near Kineton; Steeple Hill and Marl Cliff, near Bidford.

AGROPYRUM.

A. caninum, *Huds. (Triticum). Wood Couch Grass.*

Native: On hedge banks and in bushy places. Local. July.

I. Wylde Green, near Sutton; Waterworks grounds, Witton Lane; coppice, near Plant's Brook; lane by Chelmsley Wood; canal bank, Olton; Elmdon; banks by Meriden Marsh; Shelly Lane, near Shirley.

II. Myton, *Y. and B.;* Honington Park! *Newb.;* Barby Road, near Rugby, *R. S. R.*, 1876; lane from Edge Hills to Radway; Marl Cliff, near Bidford; Chesterton Wood; road from Rugby Mill to Newbold-on-Avon.

A. repens, *Linn. (Triticum.) Common Couch Grass.*

Native: On hedge banks, by roadsides, and in bushy places. Common. July, August. Area general.

LOLIUM.

L. perenne, *Linn. Common or Perennial Rye Grass.*

Native: In meadows, pastures, on banks, and by roadsides. Common. June, July. Area general.

[*L. italicum,* Braun. *Italian Rye Grass.*

Alien: By roadsides, and on railway banks and sidings. Rather common. July to September.

I. Railway sidings between Castle Bromwich and Sutton; Gravelly Hill; roadsides near Shustoke; quarries, Hartshill; lanes near Solihull; &c.

II. Honington and Tredington (escape), *Newb.;* plentiful between Stratford-on-Avon and Shipton; Alveston Heath; railway cutting, Alcester and Salford Priors; &c.]

Apparently well established in many of the districts, but probably always a mere straggler from cultivation.

L. temulentum, Linn. *Darnel.*

Casual: In rick yards, and on waste places. Very rare. July.

II. Waste places near Kenilworth, *H. B.;* rick yard at Kenilworth, abundant.

b. arvense. Very rare.

II. Waste places near Kenilworth! *H.B.* Rick yard at Kenilworth with the type.

Neither of these varieties is truly wild in this county.

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HORDEUM.

H. pratense, *Huds. Meadow Barley.*

Native: In pastures and grassy roadsides. Rare and local. July, August.

I. Pastures near Curdworth; pastures near Stonebridge; meadows near Blythe Bridge, Solihull; Bradnock's Marsh.

II. Bishop's Itchington, *Y. and B.;* Honington; Tredington, *Newb.;* Holbrook Park, *R.S.R.*, 1877; pastures near Kineton; Moreton Morrell; Alveston; Stratford-on-Avon; Bintou; Exhall; Oversley; Billesley; Great Alne; Wilmcote; Henley-in-Arden; Combe Fields, near Rugby; Birdingbury; Shuckburgh; Willoughby.

H. murinum, *Linn. Wall Barley.*

Native: On dry banks, by roadsides, more especially by towns and villages. Locally common. June to August.

I. Sutton Coldfield; Minworth; Curdworth; Olton canal bank;

II. Warwick! Myton! Kenilworth! Emscote, *H.B.;* Honington! Tredington! *Newb,;* Alveston Heath; Stratford-on-Avon; Binton; Wixford; Salford Priors; Oversley; Drayton; Wootton Wawen; Lillington; Rugby; Radford Semele; Long Itchington.

Very local and sparse iu district I.

NARDUS.

N. stricta, *Linn. Mat Grass.*

Native: On damp heaths, and heathy roadsides. Rare. May to July.

I. Sutton Coldfield! *Ick. Anal.*, 1837; Coleshill Heath! *Perry Fl.;* Middleton Heath; Coleshill Pool; pasture, Blythe Bridge; pasture by Olton Pool; Marston Green; Baddesley Common; abundant, Forshaw Heath, near Tanworth.

II. Studley Common, *Purt.*, i., 66; Haseley Common, *Y. and B.;* Kenilworth Heath! *H.B.;* Yarningal Common.

(To be continued.)

METEOROLOGICAL NOTES.—JULY, 1885.

The barometer was generally high during the month, the mean, 30·181 inches, being higher than that of July in any of the last six years, and the highest since January, 1882. The greatest pressure was on the 22nd, 30·453 inches; the least, on the 19th, 29·786 inches. Temperature was about 1 degree above the average, but the maxima were unusually high. The highest readings were on the 25th, when 90·0° was recorded at Henley-in-Arden, 89·2° at Loughborough, 87·2° at Strelley, 86·0° at Hodsock, and 85·0° at Coston Rectory. 89·7° was registered at Loughborough on the 5th of July, 1881. In the rays of the sun, 141·2° at Loughborough on the 26th, 135·2° at Strelley on the 19th, and 133·7° at Hodsock on the 26th. The lowest minimum readings were 38·0° at Coston Rectory on the 2nd, and at Henley-in-

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Arden on the 9th, 40·0° at Hodsock on the 29th, 42·1 at Strelley on the 1st, and 43·7° at Loughborough on the 2nd. On the grass, 32·7° at Hodsock on the 29th, 37·8° at Strelley, and 40·0° at Loughborough on the 1st. The past month is most remarkable for the unusually small amount of rainfall, the total values being, at Coston Rectory 0·11 of an inch, at Loughborough 0·14, at Hodsock 0·32, at Strelley 0·37, at Henley-in-Arden 0·55. The number of "rainy days" varied from 2 to 6. An exceptional fall, 0·40 of an inch, took place at Henley-in-Arden on the 21st. The absence of thunder storms is noticeable. Sunshine was above the average.

Wm. Berridge, F. R. Met. Soc.

12, Victoria Street, Loughborough.

Natural History Notes.

New British Fungi.—I was surprised to-day, on examining some fungi, collected at Sutton last March, to find that one of them was a species of Helminthosporium, new to Great Britain. It resembles *H. Hirudo*, Sacc. (Fung. Ital. 54), but differs in being nearly twice as large; the spores are about 400 μ long, very dark, with about 60 septa. I propose to name it var. *Anglicum*. I have also to record the following fungi, not hitherto, I think, detected in Great Britain: *Phoma ilicicola*, *P. lineolata*, *P. hysterella*, and *Septoria Teucrii*, all from near Hampton-in-Arden.—W. B. Grove, B.A., July 28th.

Death's Head Hawk Moth.—Two broods of caterpillars of the death's head hawk moth *(acherontia atropos)* have occurred here, the first I have met with during a residence of five-and-twenty years. One of these specimens was brought in by the vicar of Kingsbury, found by a labourer at the edge of a field of potatoes. The other three were taken feeding in a potato garden, close by the Tamworth railway stations. I attribute this appearance to the unusually dry summer we have experienced.—Egbert de Hamel, Bole Hall, Tamworth, August 15th, 1885.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Geological Section, July 28th.—Exhibits:—Mr. W. P. Marshall, M.I.C.E., geological specimens from America. Silicified wood, from Calistoga Petrified Forest, California, special piece showing fine concentric layers when magnified; Sulphur deposits, &c., from Hot Springs, Cloverdale, California, where sulphur vapour and steam issue from cracks in ground; weathered granite, from Yosemité Valley, California, spherical layers from domes, flat layers from vertical faces; granite sand, from Yosemité Valley, California, dust lying thick upon roads below granite cliffs; weathered sandstone, from Garden of the Gods, Colorado, red portion a little harder than white, forms flat caps; granite, &c., from Rocky Mountains, Pike's Peak, Colorado, partially disintegrated, and some deep red coloured granite, &c., from Rocky Mountains, Toltee Gorge, Colorado; striped sandstone from rocks, Kentucky; sundry specimens from rocks at Great Salt Lake, Utah;

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sundry specimens from rocks above Santa Fé, New Mexico; Limestone, from Manitou Cavern, Colorado, cave in limestone rock, similar to Mammoth Cave, Kentucky; ironstone from rocks above Las Vegas, New Mexico; copper ore, from Rocky Mountains Slope, Arizona, too great distance and not rich enough to pay carriage; limestone and shales, from rocks forming Niagara Falls—the shale perishes below the limestone, causing the limestones to break down. By Mr. Clarke, a slide of pond life, from King's Norton excursion, July 25th, containing *Bosmina longirostris*, *Diaptamas Castor*, *Volvox Globator*, *Spirogyra neglecta* in conjugation, *Anuræa stipitata*. By Mr. Bolton, Plumatella, from King's Norton. By Mr. Udall, a trilobite (*Calymene Blumenbachii*), from Dudley.—GENERAL MEETING, August 4th. Mr. J. Morley exhibited a fasciated stem of vine, showing its gradual division into the normal condition; also a sprig of maple (*Acer campestre*), in which the leaves were covered with the bright red galls of an insect (*Cynips*). Mr. T. Bolton exhibited *Lemanea fluviatilis* and *Batrachospermum moniliforme*, var. *pulcherrimum*, freshwater algæ, from near Llangollen; also *Daphnia reticulata*, from Sutton. Mr. W. B. Grove, B.A., exhibited the following plants from North Wales:—*Cotyledon umbilicus* (2 feet high), *Orobanche hederæ*, *Saxifraga stellaris*, *Sedum Telephium*, *Sedum anglicum*, *Drosera rotundifolia*, *Verbena officinalis*, *Orchis maculata*, *Narthecium ossifragum*, *Wahlenbergia hederacea*, *Sambucus Ebulus*, *Myrica Gale*, *Blechnum spicant*, *Asplenium Adiantum nigrum*, *Asp. Trichomanes*, *Lastrea montana*, *Polypodium Phegopteris*, *Lycopodium clavatum*, *Lyc. Selaginoides*, *Hygrophorus conicus*, *Boletus luteus*, *Helotium æruginosum* (oak impregnated with mycelium), and *Cantharellus cibarius*.—BIOLOGICAL SECTION, August 11th.—Mr. R. W. Chase in the chair. Mr. T. Bolton, F.R.M.S., exhibited *Pteronais parasita*, vulgarly known as the Polite Worm, in allusion to its habit of nodding its head and flapping its apparent wings; and *Alcyonella fungosa*, both from Alvechurch. Mr. J. E. Bagnall, A.L.S., two mosses, *Amblystegium serpens* and *Bryum cæspiticium*, curious from growing at a rolling mill, Buckingham Street, amid the splash of a mixture of vitriol, oil, and water; also a number of mosses from Cumberland and some flowering plants from the Anker district. Mr. J. Levick, *Zoothamnium arbuscula*; *Lacunularia socialis*; *Cristatella mucedo*; from Alvechurch. Mr. Browett, large female adder, *Pelias Berus*, measuring fully two feet long, together with eight young adders, measuring six inches long, taken from the inside of the mother after being killed, in the usual membrane, forming a complete egg.—GENERAL MEETING, August 18th.—Mr. T. Bolton exhibited *Verbascum Lychnitis*, the white mullein (rare), from Whittington, Kinver, and *Sabella penicillus*, a marine tube-dwelling worm, from Sheerness. Mr. J. F. Greenway exhibited *Lacinularia socialis* and *Stephanoceros Eichhornii*, from near Alvechurch. Three new members were elected.—GEOLOGICAL SECTION, August 25th.—Mr. Pumphrey exhibited a Potentilla, in which, instead of a solitary flower, two grew back to back with complete calyx and corolla. Mr. Bolton on behalf of Mr. Morley, from Llandudno, a dog-fish egg, Botryllus, and young crabs. Mr. W. B. Grove, *Lentinus lepideus*, an agaric which usually grows upon imported fir timber, but is found annually at Selly Oak, on the beams of the roof of a half buried cellar. Mr. Udall, several corals from neighbourhood of Bristol; specimen of coal from Swansea; specimen of granite from Shap.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—July 20th. Mr. Hawkes showed specimens of meadow sweet attacked with *Uromyces ulmariæ* and *Triphragmium ulmariæ*. Mr.

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Madison, specimens of henbane, *Hyoscyamus niger*, from Solihull; also specimens of *Vertigo pygmæa* from Knowle. Under the microscopes Mr. Tylar showed a section of the ovary of snapdragon; Mr. Hawkes, *Triphragmium ulmariæ*. A paper was then read by Mr. J. A. Grew on "An Insect," in which he described the vague and indefinite notions many persons had upon this subject, notions that were shared by many writers of only a few years ago. He defined the position and distinguishing features of the section Insecta of the animal world. The remaining part of the paper was taken up with a description of the peculiarities of their structure, and concluded by remarking that much yet remained to be done in working out the uses of some of the organs. The paper was illustrated by diagrams.—July 27th. The following exhibits were made by Mr. Madison: Specimens of *Ancylus fluviatilis*, var. *compressa*, from Weatheroak Hill; also a case of specimens of *Gryphea incurva* from various localities. Mr. Evans, a fossil shell *(Modiolopsis)* in a pebble from the Moseley drift. Mr. Sanderson, a series of photographic views of the Yorkshire dales, etc. Under the microscopes Mr. Tylar showed a zoophyte, *Obelia dichotoma*, with polypes *in situ*. Mr. J. W. Neville, ruby sand with fluid cavities, from New Zealand.—August 10th. Mr. Moore exhibited six well-marked varieties of *Arion ater* from the Isle of Man. Mr. Hopkins, specimens of *Valvata cristata* and *Helix sericea*. Mr. Hawkes, leaves of violet infested with Trichobasis, and leaves of *Tragopogon pratensis* attacked by Æcidium and Ustilago. Mr. Madison, a number of shells collected at Dovedale, including specimens of *Helix arbustorum*, var. *cincta*, also var. *flavescens; H. ericetorum*, var. *minor; Ancylus fluviatilis*, var. *alba;* etc., etc. Then followed a paper, "Notes on the Green Woodpecker," by Mr. P. T. Deakin. The writer described the habits of the bird, and the order to which it belonged. The peculiarity of the legs and claws was pointed out as adapted to the habit of climbing and supporting the bird while it obtains its food, which is procured by tearing off the bark of trees, and consists of the larvæ of wood-boring beetles, etc. The habits of nesting, colour of eggs, plumage of young, etc., was dwelt upon, and the whole illustrated by wall pictures and stuffed specimens of the green woodpecker and its allies.—August 17th. The President in the chair. Mr. Deakin exhibited a collection of shells from the King's Norton district. Messrs. Madison and Hopkins, specimens of *Helix rotundata*, var. *alba*, and *Clausilia rugosa*, var. *albida*, the latter new to the district. Mr. Tylar, a zoophyte in spirit, *Aglaosphenia myriophyllum*. Mr. Delicate, two plants, one a native rose from Manitoba. Under the microscopes Mr. Moore showed palates of *Zonites cellarius* and *Neritina fluviatilis*. Mr. J. W. Neville, the brittle starfish, *Ophiocoma neglecta*. Mr. Hawkes, a type slide of five micro-fungi, showing degrees of complexity of spores from Puccinia to Xenodochus. Specimens of the infested plants were also exhibited.

CARADOC FIELD CLUB.—On Wednesday, June 17th, this club made the second excursion of the season to Bishop's Castle by railway, thence proceeding by carriages to the Bishop's Moat, an extensive earthwork on the extreme border of the county, consisting of a lofty mound raised for a point of observation and signalling, surrounded by a ditch, and protected by a camp, which it joins, also surrounded by a ditch. The Bishops of Hereford, somewhere about the eighth century, had a large estate granted to them of 18,000 acres by Egwin Shakehead, which being in near proximity to Wales, they had to defend, for which

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purpose they utilised this, probably already existing, earthwork, hence the name Bishop's Moat. Near here were found growing *Narcissus poeticus*, *Viola lutea*, *Orchis morio*, *Heracleum sphondylium*, form *angustifolium*, Sm., and *Prunus padus*, the fruit of which was strangely deformed by a fungus—*Ascomyces Pruni (Tul)*, not hitherto (we think) recorded for Britain. The fruit was elongated so as to resemble the pod of a *Genista*. The party then visited another ancient encampment, Cær-din, commanding a magnificent view of Corndon mountain and stiperstones. Mr. R. Parry gave an interesting address on the geological features of the surrounding district, in the course of which he pointed out the changes it had undergone since Corndon was an active volcano. The President, the Rev J. D. La Touche, supplemented these remarks by a highly interesting address, confirming Mr. Parry's views. Offa's Dyke was the next object of interest, which is in wonderful preservation here, and impressed all minds with the magnitude of this Saxon boundary. The Hon. Secretary, the Rev. T. Auden, read an excellent paper on its construction, extent and object, and the traditions pertaining to it. The third excursion was to Dolgelly, July 28th to 31st, when Cader Idris was ascended, where many botanical treasures were seen, but treated with due forbearance. It was gratifying to see that many rare plants still hold their own in the wilder parts of this noble mountain, in spite of the rapacity of some calling themselves botanists. Cymmer Abbey, the Vale of Ganllwyd, Pistyll-y-Cain waterfall, and other picturesque localities were visited on the second day, and altogether the members of the club had a most enjoyable time.

DUDLEY AND MIDLAND GEOLOGICAL SOCIETY.—A large party of the members of this Society and their friends visited Buildwas and Wenlock Abbeys on Tuesday, the 18th of August. After seeing the ruins of Buildwas, the members were permitted by the kindness of Mrs. Moseley, who lives in the Abbot's house, to go into her hall, which is paved with ancient tiles found in the Abbey ruins. These are very curious, several having the pattern traced upon them with a style before being baked. Between Buildwas and Wenlock, the Bradeley Limestone Quarries were visited, where a number of characteristic Wenlock fossils were found, including *Euomphalus discors*, *Favosites Gothlandicus*, and *F. Forbesi*, *Heliolites megastoma*, and *H. interstinctus*, *Atrypa reticularis*, *Orthis*, *Cyathophyllum*, *Stromatopora*, &c. At Wenlock, after examining the ruins of this once famous and extensive Abbey, by the permission of C. M. Gaskell, Esq., the members went over the Prior's House, now Mr. Gaskell's residence. The house contains a great deal of original old furniture and wood-carving, formerly belonging to the Abbey. In the course of the day the botanists found the following plants:—*Chelidonium majus*, *Cheiranthus cheiri*, *Hypericum hirsutum*, *Agrimonia eupatoria*, *Poterium sanguisorba*, *Anthyllis vulneraria*, *Genista tinctoria*, *Pimpinella saxifraga*, *Ononis arvensis*, *Sedum reflexum*, *Dipsacus pilosus*, *Arctium majus*, *Picris hieracioides*, *Artemisia absinthium*, *Lactuca muralis*, *Erigeron acris*, *Inula conyza*, *Chlora perfoliata*, *Senecio erucifolius*, *Sclerochloa rigida*. The Rev. J. H. Thompson exhibited *Lysimachia vulgaris*, from Moccas Park, Herefordshire, and a plant he believed to be *Sparganium neglectum*, lately described in the "Journal of Botany" as new to the British Flora, from Hurcott, Kidderminster. Mr. Horace Pearce exhibited *Silene maritima*, in flower, from Pwllheli; *Verbascum Lychnitis*, *Potentilla argentea*, and *Plantago Coronopus*, from Whittington, near Kinver; *Erodium maritimum*, from Habberley Valley, Kidderminster.

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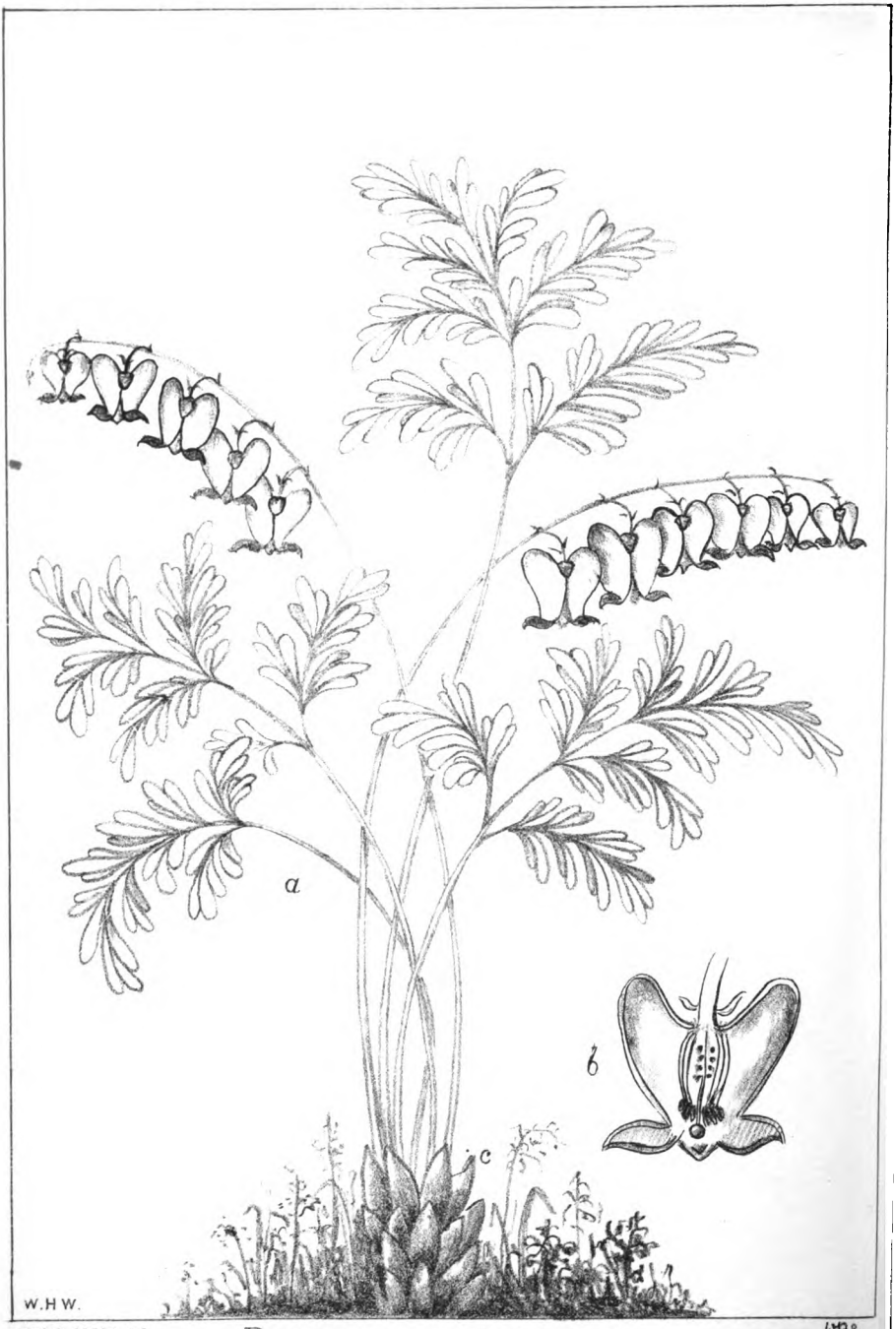
Plate VI.



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DICENTRA CUCULLARIA

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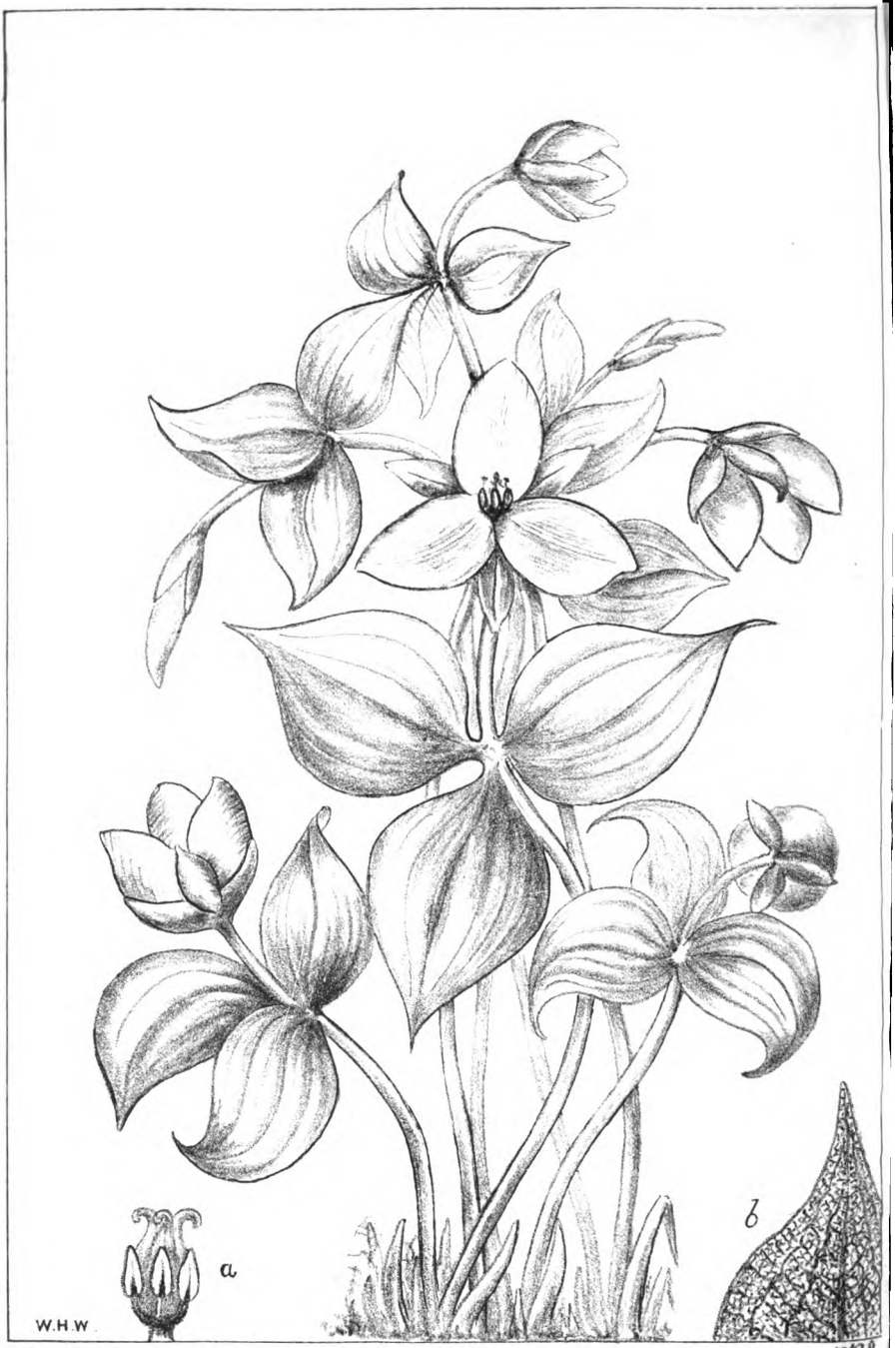

HERALD PRESS, IMP.

TRILLIUM GRANDIFLORUM.

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NOTES ON THE FLORA OF AMERICA,*

MADE DURING A TOUR IN THE NORTH-EASTERN STATES IN APRIL, MAY, AND JUNE, 1882.

BY W. H. WILKINSON,

HON. SEC. BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

On landing in New York City in the middle of April, we were surprised at the beautiful weather, for the sky was almost without a cloud, and the deep blue contrasted with the red brick buildings most vividly; the clearness of the atmosphere was perhaps partly due to climatic causes and partly to the use of anthracite coal, which makes no smoke; the result being very favourable to the cleanliness of the buildings and to the purity of the atmosphere.

New York is built on a tongue of land some eleven miles long, the southern portion of which is covered to a considerable depth with sand, thus causing much trouble and expense in getting good foundations for their buildings; and also is not favourable for the growth of the ornamental trees and flowers in the southern and busiest portion of this great city, but as you advance further north the schistose rock can be seen cropping up, so that in Central Park there is a fine state of cultivation attained and many rare plants and trees are grown; the Park is laid out with great skill, some parts being depressed and filled with ornamental lakes, and others raised and embellished with statuary and rockeries, the National museums being situated in isolated blocks within the park enclosure.

Our first introduction to the flowers of America was in one of their most appropriate places, viz., in the adornment of the ladies' dresses, it being the fashion in New York City to wear eight to ten full-blown roses grouped on the front or side of the dress, as they walked "on Broadway" or Fifth Avenue. It must have been a costly luxury then, as there

DESCRIPTION OF PLATES.

PLATE VI.—*Dicentra cucullaria* (White Ear-drop). Flowers white, with velvety maroon tips. A beautiful and delicate woodland plant, growing on islands, Niagara Falls. (*a*), Plant, half natural size; (*b*), section of flower with six stamens; (*c*), scale-stem.

PLATE VII.—*Trillium grandiflorum*. Flowers usually white, sometimes pink. Frequent in shady woods, Niagara Falls, &c. (*a*), Centre of flower; (*b*), stamens, tripartite stigma; (*c*), part of leaf, showing the palmi-net-veined structure.

* Transactions of the Birmingham Natural History and Microscopical Society. Read March 31st, 1885.

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was no sign of growth amongst the flower gardens of the district; all were grown under glass, and realised from 1s. to 2s. each blossom in the shops.

Our first impression of the American landscape was its similarity to our English scenery, being composed of trees, shrubs, flowers, and grass, most of which from a distance looked about the proportion, size, and colour of those at home; but on closer examination every one seemed a little different in some detail or other, the trees differed in species, the flowers in form and colour, and even the grasses, which were mostly coarser than ours. Perhaps a few illustrations from some of our commonest and best known flowers will best enable us to realise this difference.

The nurserymen seem to grow most of our greenhouse flowers, and to about the same state of perfection; but the private conservatories appear to be much neglected; the "mighty dollar" evidently engrosses the attention of "paterfamilias." But the alteration of climate makes a great change in out-door flowers; they have a far greater amount of heat in the summer and a much more intense frost in the winter than we ever get. Hence a number of plants which do well with us die directly with them; for instance, we consider the ivy a common hardy plant, but it dies if exposed to their winter frosts, and they cultivate it in pots to ornament their houses and train round the inside of their windows. Again, the most common—and by the children the most prized—of flowers is the English daisy, *Bellis perennis*. But although I looked carefully, I never saw one in America; I suppose the winter kills them, and even if they survive the frost, the drought of August would kill them. Once I thought I had found one, but on gathering it it was quite a different plant (*Aster spectabilis*), but I have laid it before you to-night that you may see how very much the blossom resembles our pretty English daisy.

Now, on the other hand, the garlic is not very common with us, while it has been taken over from Europe to New York, and has now spread for 200 miles inland and grows as common there as grass. The hawthorn was also absent, their hedges being made of other shrubs near the towns, but in the country either by trees cut from the forests forming a "snake" fence or by galvanised wire, certainly not very picturesque, however economical it may prove to the farmer. The golden buttercups were scarce but I gathered four different kinds, but none grew in the rich profusion of our field buttercup.

I was much charmed with the beauty of the peach blossoms; near Baltimore large tracts of land are given up

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to their cultivation; the deep pink blossoms coming out before the leaf. The finest growers only crop their trees for three years, then replace them, but the amount of fruit grown is enormous, as you may judge when I tell you that the carriage of peaches in two months pays the dividend on a branch line for the whole twelve months. At Baltimore 10,000 persons are employed to "can" the peaches and oysters, which are brought up Chesapeake Bay, and are then sent out all over the civilised world.

In some places the dandelion (*Taraxacum dens-leonis*) was growing in great abundance; for instance, it gave quite a gay effect to the greensward of the public park at Pittsburg; and perhaps some of our friends who are not epicures will be surprised to hear that dandelion salad is quite a recherché dish. The Yankees are great upon oysters; immense quantities are eaten in the large cities, and you will often find them cooked in four or five different ways; and as if not satisfied with Father Neptune's supplies they grow oyster plants, but I did not appreciate them, the flavour reminded me so much of parsnips.

The size of their country, stretching far into the tropics, and their vast railway systems, afford to New York a supply of fruits and fish that perhaps no other city has ever dreamed of. In London, I know, you can buy simply anything, but you must pay for it; but here in New York the quantity is equal to the demand, and hence is obtainable by all.

At Philadelphia, near to Independence Hall, where the Declaration of Independence and many relics of the Rebellion of 1776 are most carefully preserved, is Washington Square, which is said to contain a specimen of each of the trees which grow in the States; but if ever such a collection was planted there a vast number must have perished, as there is little left to make it attractive now. But just outside the city is Fairmount Park, which extends along both banks of the Schuylkill River, is seven miles long, and is said to be the finest park in the world.

In Washington the streets are wide and flat and paved with asphalte, and are mostly planted with two rows of trees; some of the avenues are lined with the White Poplar (*Populus alba*), the cottony seeds of which were blowing about and piled into heaps like snow in a snowstorm. At Washington we visited the far-famed Smithsonian Institute, with its fine collection of specimens, the conservatory of which contains, besides a fine group of Australian ferns, 110 species of palm trees and the finest collection of insectivorous plants I have met with.

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I might mention here a curious incident. For the previous month we had been travelling northwards at about the same rate that the spring advanced; for instance, on May 3rd, in Washington, we saw the lilac and chestnut trees in bud, just ready to burst out; and in every town we visited we found them in just a similar state, even to Montreal on June 3rd, but during the week of our stay here, summer broke upon us in all its glory and beauty, so we were at once plunged from early spring right into the heat of midsummer; and from this point during the whole of June, as we pursued our course southward through the valley of the Adirondack, crossing Lake George and along the valley of the Hudson River to New York, we were delighted in the extreme with the abundance, the luxuriance, and the freshness of Flora's gems.

During the earlier part of our tour there were but few flowers in blossom, but by the time we reached Niagara Falls the spring had advanced considerably, so that I was able to obtain from there many very beautiful flowers, mostly new to me. I worked carefully up the Canadian shore of the Falls for some miles, and also the charming groups of the Cedar and Clarke Hill Islands as far as the Burning Spring. Another charming spot was the St. Helen's Island, in the St. Lawrence River, and Mount Royal at Montreal; and a third delightful and successful locality was the Lake George district, near the Adirondack Mountains, including the Au Sable Chasm, a perfect paradise to the botanist, and indeed to anyone else with a love of Nature.

(To be continued.)

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

PART I.

(Continued from page 255.)

Some Sections Illustrating the Development of the "Spinatus" Zone and Transition Bed.

Sections in the "*Spinatus*" *Zone* are much more numerous than in the *Margaritatus*, but they seldom show anything below the rock-bed. This is chiefly due to the fact that the rock-bed is the only portion of the Upper Middle Lias that is now used in the district. It may be well, perhaps, to state here that by some geologists the rock-bed is regarded as itself constituting the "*Spinatus*" *Zone*.

On looking at a geological map of Northamptonshire it will be noticed that the Middle Lias outcrop takes a direction

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approximately from north-east to south-west, but that there is a considerable easterly extension of it fairly parallel with and on both sides of the River Nen, to within about two miles of Northampton. Over very much of the area which is shown as Marlstone in the maps of the Geological Survey there is a thin capping of Upper Lias* which, although ignored, is rather important as affecting the quality of the rock below, and the amount of water received by it.

Beginning at the extreme south-western portion of the county, we find a most interesting exposure of the rock-bed at KING'S SUTTON. The rock here is rather rich in iron, and was for some time worked as an ironstone. This quarry has yielded more rare and interesting fossils than any other in the county; they include *Ammonites spinatus* (certainly rare in Northamptonshire), a large *Pleurotomaria*, *Trigonia Lingonensis*, *Crania Griffini*, *Spirifera oxygona*, *Spiriferina Walcottii*, *Spiriferina rostrata*, three species of *coral*, and a *dichotomous Ceriopora*. Most of the commoner fossils are also found, and some in abundance.

The King's Sutton section and many others in the neighbourhood of Banbury have been described by Mr. T. Beesley, F.C.S.,† and Mr. E. A. Walford, F.G.S.,‡ and I gladly ackowledge the assistance I have received from their pamphlets, particularly Mr. Walford's, as treating of sections chiefly in Northamptonshire.

The King's Sutton quarry has been so long disused that comparatively little can be got there now. A somewhat similar section may, however, be examined on the other side of the valley, at Adderbury.

There are three or four sections near to THENFORD, and one rather a good one, although on first visiting the neighbourhood I was assured by an inhabitant that there were no stone pits about. The section is as follows:—

SECTION OF QUARRY SOUTH OF THENFORD.	Feet	In.
1.—Soil	1	0
"Communis" Beds—		
2.—Light-coloured marly clay, with many small *Ammonites* and *Belemnites*	2	6

* See sections to follow.

† "A Sketch of the Geology of the Neighbourhood of Banbury," by Mr. Thos. Beesley, F.C.S.

‡ "On Some Middle and Upper Lias Beds in the Neighbourhood of Banbury," by Edwin A. Walford.

Both published by the Warwickshire Naturalists' and Archæologists' Field Club.

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"Serpentinus" Beds—

3.—Lower Cephalopoda Bed; a white limestone with reddish exterior, containing many *Ammonites of the falcifer group*	0	6
4.—Light-grey clay or shale with red streaks in it ...	0	10

Fish and Insect Beds—

5.—Grey shale ... ... 1¾in.		
6.—Red sandy shale ... ... 2¼in.		
	0	4
7.—Fish-Bed, very soft, only a little hard piece in the middle, sometimes nodular, shaly, not persistent, containing *fish scales*, &c.	0	2

Transition Beds.

8.—Red sandy clay, shaly at top	0	7
9.—Transition-Bed, not distinctly separable from the bed below		
"Spinatus" Zone of Middle Lias.		
10.—Rock-Bed, a hard ferruginous rock, much of it of a bluish green colour, fossils very abundant, *Belemnites paxillosus*, *Rhynchonella tetrahedra*, *Terebratula punctata*, *Waldheimia resupinata*, *Ostrea sportella*, &c.... ...	6	0

The beds 5 and 6, and the upper part of 8, I believe to represent the *paper shales* of Gloucestershire, for fish remains seemed about as common in bed No. 5 as in the fish bed itself, though they were not abundant in either. In the rock-bed there are two or three layers composed almost entirely of *Rhynchonella tetrahedra*. These layers are called "*Jacks*" by the quarrymen in Rutland, and the term is now frequently used by geologists.

About two hundred yards west of the section above described is another, which is about as follows:—

	Feet	In.
1.—Soil and rubbly stone—disturbed rock	2	9
2.—Rock-bed, not very ferruginous, very rubbly, near the top two irregular bands of ossicles and broken shells. Most of the fossils casts. *Pectens*, *Rhynchonella tetrahedra*, *Terebratula punctata*, &c. No "Jacks."	3	6
3.—Red sand, which is either the base of the rock-bed or a sandy layer in it. The best specimens of Terebratula and Rhynchonella were got from this... ... ... shown	1	0

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The badly preserved nature of the fossils at this quarry is no doubt due to the absence of a clay capping.

When the first of the two quarries just described was being worked some twenty years ago a small fault was noticeable; and a figure of it occurs in the "Memoirs of the Geological Survey," description of sheet 45 of the maps. In this diagram the Upper Lias, with two of the limestone bands near its base, are shown abutting against the Middle Lias rock-bed at an angle of about 30°. The faulting was thought to be very slight, and the geological maps show only a very small patch of Upper Lias let in. The construction of a well some fifty yards north-east of the quarry has, however, shown that the fault is much more extensive than had been anticipated, for the well being commenced about thirty feet above the level of the brook, passed through sixty-five feet of blue clay before water was obtained. The blue clay was very unfossiliferous; but Mr. Beesley, who was consulted in the matter, before water was obtained, identified it as Upper Lias by the *foraminifera* it contained; this was afterwards confirmed by other fossils from the lower part. Mr. Beesley says, in a paper he read before the Banbury Natural History Society, that not far from this spot a well was sunk fifty feet in vain, and water only obtained by boring, when it rushed in with great violence; also, that some wells at Lower Middleton Cheney are eighty feet deep, thus pointing to a probable extension of the fault in that direction.

The Marlstone rock-bed is again met with in its normal position in Thenford, about a quarter of a mile north of the quarry; indeed, the main street has been partly cut through it, and it forms the foundation of walls of houses both here and at Middleton Cheney.

About a quarter of a mile west of Thenford there is another Marlstone quarry (Boucher's Pit), long disused, however. A distinct band of ossicles occurs about two feet from the top, the thickness of the entire bed being about five feet. It is capped by the Serpentinus and Fish and Insect beds, as in the quarry south of Thenford; the Fish bed is, however, much better preserved.

Still another quarry is to be seen a little way out of Thenford towards Middleton Cheney, but from long disuse very little besides the *Communis beds* of the Upper Lias can be now examined.

Near to Middleton Cheney we again find Marlstone quarries, though few of them show signs of having been

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worked recently. To the north-east of the village there is a small quarry, called the Rectory Pit, presenting the following section :—

RECTORY PIT, MIDDLETON CHENEY.	Feet	In.
1.—Soil	1	6
Upper Lias.		
2.—Marly clay, light coloured, with pieces of white limestone in it—the remains of the UPPER CEPHALOPODA BED; *small Ammonites* of the planulate group abundant	2	0
3.—White limestone, containing many *Belemnites* and *Ammonites*, the latter chiefly of the falcifer group; also *Nautili*, &c. (THE LOWER CEPHALOPODA-BED)	0	6
4.—Shale or clay containing a few *Belemnites*... ...	0	1½
5.—Sandy limestone—(FISH-BED)	0	4
Middle Lias.		
6.—Grey marl, containing *Ammonites acutus*, *A. Holandrei*, &c.	0	2
7.—MARLSTONE ROCK-BED, with the usual fossils :— Bands of *Rhynchonella tetrahedra*, *Waldheimia resupinata*, *Ossicles*, &c.		

In an adjacent field is another Marlstone pit, which, having been more recently worked, presented a better section of the rock-bed. The section was as below :—

1.—Soil, with fragments of the LOWER CEPHALOPODA-BED containing the usual fossils, and also the rarer ones *Rhynchonella jurensis?* and *Dentalium liassicum*.
2.—Red clay ; true transition-bed indifferently shown.
3.—ROCK-BED, rubbly, weathered surfaces rather red, most of the fossils particularly large. *Belemnites*, *Pecten æquivalvis*, *P. liasinus*, *Hinnites*, *Plicatula spinosa*, *Rhynchonella tetrahedra*, *Terebratula punctata*, *Bands of Ossicles*, *Pebbles*, *&c.*

Near the above, and beside the road leading across the hill to Chalcomb is another small pit showing only the rock-bed, and that not very well. The following fossils were noticed—*Pecten æquivalvis*, *Plicatula spinosa*, *Terebratula Edwardsi*, *Rhynchonella fodinalis*, *R. tetrahedra*, *Ossicles*, *Pebbles*, *&c.* We were informed that the Wesleyan chapel at Chalcomb was built with stone obtained here.

On the top of the hill, towards CHALCOMB, the rock-bed forms the subsoil, and pieces of the rock are plentifully

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strewn on the ground; also a small quarry may be seen, exposing a section of three or four feet; it is very similar to that at the base of the hill. Here, and at other places around Chalcomb, the Middle Lias rock-bed seems to follow the undulations of the ground, and is met at such different levels as to suggest that the hills are due to elevation and not to denudation as in most other places in the county.

In and around CHALCOMB there are several sections of the Marlstone; one by the side of the Thorpe Mandeville road shows a small fault; the light-coloured clay of the lower part of the Upper Lias being brought, for a short distance, side by side with the rock-bed. Another section in the village exposes about five feet of a rather soft rubbly stone, containing many fossils of the common kind, also calcspar. On a hill to the south-east of Chalcomb there are two or three small quarries, and a year or two ago one in the middle of a cornfield was being worked for road metal. In the district around Chalcomb there is no clay capping to the rock-bed, hence the stone is very much fissured and broken, and fit for little besides road mending; it has, however, furnished a rich red soil, very well suited to wet seasons because of the very good natural drainage it allows. On making enquiries I was informed that this district suffered very little from the heavy unseasonable rains of a few years back.

I believe there are no exposed sections of the Marlstone north of Chalcomb until we reach EDGCOTT, a distance of about 2½ miles. Near to Edgcott Church we find a small quarry that is occasionally worked for road material. The soil above it contains broken pieces of limestone, with *Ammonites serpentinus*, *A. communis*, *&c.*, which are evidently the remains of the Lower Cephalopoda bed. Some very fine specimens of *Rhynchonella tetrahedra* were obtained from the heaps of stone near at hand.

(To be continued.)

THE EAR AND HEARING.

BY W. J. ABEL, B.A., F.R.M.S.

(Continued from 217.)

II. *Pitch*, supposed to be discriminated by the responsive vibration of the rods of Corti, signifies the acuteness or graveness of the sound as determined by the ear; and is resolvable into the rate of vibration of the sounding body.

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Dr. Wollaston considers that the degree of tension of the tympanic membrane affects our sensibility to pitch, and he thus explains the functions of the tympanic muscles. The *Tensor tympani*, which is inserted in the upper part of the handle of the malleus, by its contraction tightens the membrane; the *Laxator tympani*, inserted in the processus gracilis of the malleus, is supposed by some to assist in relaxing the membrane upon the remission of the action of the tensor; and the *Stapedius*, attached to a loop in the neck of the stapes, is supposed to govern the contact of this bone with the membrane of the oval foramen,—the tensor tympani concurring with it to tighten the membrane. From his experiments upon the effects of tension of the tympanic membrane, Dr. Wollaston concludes that a tense state of the membrane deadens its susceptibility to the effect of intense and grave sounds, as the firing of cannon, the rumbling of carriages over a bridge, &c., whilst it increases susceptibility to shrill sounds. The action of the muscles would seem to be in a measure voluntary, coming into play in the acts of listening and of preparing the ear to resist loud sounds,—in which condition I fancy I can myself detect a feeling of tension in my ear—though they must be largely reflex, called into action by the intensity of the sound itself.

One may render tense his own tympanic membrane by a strong continued effort of expiration or inspiration, keeping the mouth and nostrils closed—in the one case forcing air into the tympanum, tending to make the membrane convex towards the external meatus, and in the other case extracting air and making it convex towards the interior—in either case producing temporary dulness of hearing.

The gravest sound audible to the human ear is (according to Helmholtz) produced by 16 vibrations a second, the highest audible sound corresponding to 38,000, or, according to some, 50,000 vibrations a second—one of the deepest tones in use on orchestra instruments is the E of the double bass, giving 41½ vibrations a second, and the highest, the D of the piccolo flute, is 4,752. The practical range is thus about seven octaves; at the upper limit of hearing persons differ as much as two octaves; the squeak of a bat and the sound of a cricket are unheard by some ears.

A sound of uniform pitch is a musical note, the fact of uniform continuance inducing a pleasure of the nature of harmony.

The pleasurable and other effects of music open out a field much too wide for our present consideration. Spencer holds that the characteristic depth and vagueness of the

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sentiments awakened by musical tones are due to myriads of associations with the voice, vocal cries having been the commonest mode of expressing emotion through the various stages of animal development; whilst Darwin referred this phenomenon more especially to associations of vocal sound and deep sexual emotion built up during the courtships of unnumbered species; but we must leave this interesting subject for treatment by others.

Irregular vibrations produce simply noises, the perception of which some consider to be mainly due to the irregular irritation of the nerves by the otoliths. Although in music less intervals than a semitone are not admitted, the ear can distinguish still smaller differences. A quarter tone makes a marked difference to an ordinary ear, whilst a good musician can distinguish two tones whose vibrations are as 1,149 to 1,145, sounded after each other, and even a smaller difference if they are sounded together. Two pitchforks, whose number of vibrations per second are 1,209 and 1,210, sounded simultaneously can be distinguished by a first-rate ear.

The concurrence of two or more sounds may be pleasing or displeasing, irrespective of their individual character. The pleasurable concurrence is called *harmony*. It is dependent upon the numerical vibrations of the two sounds. Simple ratios as 1 to 2 (octave), 2 to 3 (fifth), 3 to 4 (fourth), 4 to 5 (major third), 5 to 6 (minor third), are harmonious in the order stated. All these are admissible in musical composition, and are termed *chords*. The combination 8 to 9 (a single tone) is a *dissonant* combination; 15 to 16 (a semitone) is a *grating discord*. In the lowest audible notes, as in a very deep organ note, the auditory sensation tends to lose itself in the tactual and organic sensations due to the vibration of the air, floor, &c. The *duration of an impression of sound* would appear, from the experiments of Savart, to be less than one-tenth of a second, since a series of beats begins to be felt as continuous when it numbers ten to twelve per second.

III.—*Quality, timbre*, or *klang*, is explained by Helmholtz by the presence of auxiliary *upper tones, e.g.*, it is found that a note sung by the human voice, or struck on a violin, is much fuller and finer in quality than one uttered by a flute, and this difference exactly corresponds to the variation in the number of the upper tones present. When the note is nearly destitute of upper tones, as in the case of a stopped organ pipe, it is thin and poor, and does not minister to the proper enjoyment of klang. He also states that the difference in the vowel sounds is due to the nature of the upper tones associated with the ground tones, *e.g.*—

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In *u* (*full*) the ground tone is heard alone;
,, *o* (*oh*) the next octave is audibly combined with the ground tone;
,, *e* (*get*) the ground tone is strongly mingled with the second octave above;
,, *i* (*bit*) the ground tone is weaker, and the second and fourth octaves above strong;
,, *a* (*ah*) the ground tone is modified by the marked presence of the fifth, sixth, and seventh octaves above.

He applies a similar principle to explain differences in the consonant sounds; but in these the distinctions are generally so palpable that the different shocks they cause to the nerve of hearing seem generally a sufficient explanation.

The theory of Helmholtz may be summarised thus:—

I.—That what appears to us to be a simple sensation of tone is a composite mass of sensations resulting from a fusion of a ground tone and several feebler upper tones, each of these elements being transmitted by a distinct nerve fibre, and that each individual tone is itself the produce of hundreds or even thousands of vibrations, each probably causing some physical change in the nerve of hearing, though not sufficiently intense to rise into consciousness.

II.—The harmony of two tones is referred to the purely negative condition of non-disturbance between the prominent upper tones of the two notes—or that harmony arises from the union of two masses of tone, each of which affects a plurality of nerve fibres, and the elements of which are in no case so near to one another as to produce intermittent shocks of tone. That is to say, that just as a single musical clang is demonstrated to be an enormously complex product, so harmony is proved to be a more complex product of this product; and *finally*, that the pure pleasure of *melody* arises from the presence in sequent clangs of some common tonic element which serves to bind them together by a simple bond of sensuous resemblance.

Auditory spectra or *subjective sounds* such as singing, buzzing, ticking, snapping, humming, &c., accompanying overwork and disease, the noise persisting after reviews, railway, coach, or steamship travelling, &c., arise from disease of the brain or nerve, pressure of congested blood vessels upon the auditory nerve, over-stimulation of the nerve, inducing a temporary morbid condition, obstructions in the tympanum, Eustachian tube, &c., and seem to prove conclusively that *sound* (like other sensations) *is essentially a state of a special nerve* (here the auditory) excited externally

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or otherwise. The interference with hearing caused by bodily affections, as diseases of the abdominal viscera, and febrile affections, may be largely caused by the sympathetic affection of the auditory nerve, though they frequently depend upon partial or complete occlusion of the Eustachian tube and external meatus by the congestion of their walls or surroundings.

(To be continued.)

A FUNGUS PHANTASY.

Vertumnus speaks:—

This is the fated day when toadstools grim,
And harmless mushrooms, in sad livery dim,
Meet on October's brown and sodden banks,
Exchange their confidences and re-tell,
In murmurs husky, what to each befell,
Since last the Woolhope thinned their gathering ranks.

"Oh! a merry, merry crew are we,
What pranks on the men we play!
Bacillus the slim, Bacterium stout,
Staid Coccus, and Vibrio gay.

In France and in Spain we have been,
And revelled 'neath Italy's skies;
We compass the world with our terrible band,
And hide in most varied disguise."

"Wilt list to the lay of a Myxomycete?
A fungus primordial I;
Of race undefined, half-animal still,
To class me in vain you may try.

Not even a Zopf the enigma can read,
Nor De Bary my lineage tell;
So gruff Rostafinski the riddle has shirked,
And Sachs has been puzzled as well."

"Petted and *cultured*, a glorious fate,
Ours is a destiny certainly great.
Specialist, amateur, all hold us dear,
Only the farmer and gardener fear.

Neatest of all, on leaves living we riot,
Not, as the mob, confined to one diet;
We travel in state, and enjoyment derive,
Though our *hosts* be reluctant, we fatten and thrive."

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"Ah! behold us, slighted beings;
Moulds both blue and green and red,
White and olive, brown and golden,
Scarcely dare to raise the head."

"We come, the *élite*, the *crême de la crême*,
For the lords of the Fungi make way!
The tough Hallimasch, Lamb's Kidney, Earth-star,
Coprinus that fades in a day,

The Fairy Champignon, in fable renowned,
The Oyster, the meek Chantarelle,
The nutty Bolétus, the juicy Beef-steak,
Rare Truffle, and fragrant Morell.

Then bring Witches' butter, and Cyathus' eggs;
We'll *cooke* you an omelet dainty and nice—
So dainty, no *fillips* your appetite needs,
'Twill *plow right* to the core of your heart in a trice.

Peziza herself shall the goblets provide,
Theléphora cover the board,
The Royal Agáric preside at the feast,
And on ketchup get drunk as a lord."

Talk ended, "Let's finish our pleasant *séance*
With a grand pyrotechnic display,"
Said young Gunpowder Sphæria, proud of his name,
And the Puff-ball inclined the same way.

Then faint phosphorescing, from mouldering trees,
Rhizomorpha illumines the gloom;
The balloons of Sphæróbolus rise in the air,
And the guns of Pilóbolus boom.

Hush! silence descends; the pale yellow moon
Peeps peacefully over the hill.
No more Peronóspora waves in the breeze,
And the quaking Tremella is still.

GAMMA.

October 1st.

ANTHROPOLOGY, ITS MEANING AND AIM.*

BY JOSEPH SMITH, JUN., M.A.I.

The progress which has within the last fifty years been made in the investigation of those matters which trench on the borders of recognised science, or form great factors in the establishing of presumed science on a firm basis, is one which must prove of the utmost importance to those interested in the advance and development of science and scientific undertakings.

* Read at a meeting of the Warrington Field Club, Feb. 6, 1885.

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In the earlier days those interested in many—more correctly speaking—in most of these scientific experiments did not, however, meet with the encouragement their labours demanded nor receive the honour merited. Geology only comparatively late has become recognised as a science, and as such established; while Mesmerism or Animal Psychology only within recent years begins to receive the attention a new science ought to demand. The supporters of every branch of scientific study have had to encounter these difficulties, brought about by opposing and contending principles. Astronomy even, by whose laws the heavenly bodies are traced in their courses, each one separate, yet all performing a part in one harmonious whole, had its advance staggered, checked, and opposed by the introduction of theories propounded for the purpose of proving such laws untenable. So also the science of Anthropology has only recently been put forward to its place in the scientific cycle.

Anthropology, the study of man, derived from the Greek words ἀνθρωπος, "man," and λογος, "discourse," signifying a discourse on man, may be more correctly defined as "a promotion of the study of the science of mankind, by an accumulation of observations bearing on man's past history, and his present state in all parts of the globe." One of the greatest difficulties indeed is the multifarious features that the study embraces, and that range themselves under this branch of knowledge. One of the chief factors of Anthropology is Ethnology. This may be taken as the earlier title of the study under consideration. It had, however, a far more limited and definite line of research, yet it was regarded as a whole, complete in itself, and so far as it went, embraced all that was then required; for the knowledge of the bearings of Anthropology was then limited, but under the development of this science we find it falling into a place, and assuming a very important factor in the study of man. Ethnology, likewise derived from the Greek words ἐθνος, "a nation," and λογος, "discourse," embraces the study of the various peoples or races which form the population of the globe, with their physical and moral development, languages, social customs, opinions, beliefs, origin, history, migrations, present geographical distribution, and relative position to each other. The study of Ethnology is two-fold. Firstly, by considering the laws which have determined and regulated these characteristic features, which is therefore called "general Ethnology;" and secondly "by a study, comparison, and description of the races themselves as distinguished from each other by the special manifestations

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of these characters in them," which is embraced by the term "special Ethnology or Ethnography." Such is the definition of this interesting branch of the science as submitted by one of the leading anthropologists of the day. As now understood, however, Anthropology treats of man as a whole, and in doing so draws for assistance on the allied sciences—zoology, comparative anatomy, physiology—in order to demonstrate more concisely the development of the masterpiece of the Creator's handiwork. His origin also comes in for an amount of investigation. This enquiry immediately suggests to the student the great questions—whether man is a new-comer on the earth or an old inhabitant,—what his relation to the rest of the universe,—whether all races are different and have appeared as we now find them, or have assumed their present state and form through a long series of ages.

Now, in examining questions so intricate and important, the wider the range of knowledge which can be brought to bear on the matter, and the greater the comparison offered, the less risk there is of error in distinguishing, and assigning to man, his correct position amongst his zoological allies. Moreover, the position and place held by man in the zoological cycle is not the only point which has to be established, but also the development of his moral and intellectual faculties; and Psychology, which is now demanding from scientists so much attention and investigation, must be embraced as another important factor in a complete system of Anthropology. Again, Geology has to be called in to render its quantum of light, and enables the enquirer to fix the age of the strata in which man's remains have been found, and the position he held in those early times, and consequently provides some chronological data as to the age of man; but in tracing the origin and progress of man from his primitive condition the characteristic resemblance to the lower animals is quickly left behind, and, says Professor Flower, "It is on evidence of a kind peculiar to the human species, by which man is pre-eminently distinguished from all living beings, that our conclusions exist." The knowledge we gain of man in the earlier period of his existence by the assistance of prehistoric archæology, helps us in the investigation of all human culture, and assists us in tracing back to their origin, the arts, customs, and manners of man. Yet in following an argument on these lines, the difficulty crops up as to what must be included, and what must be excluded, as though the term *prehistoric* marks the boundary between the historian and anthropologist, yet it is perfectly evident that the one unconsciously lapses into the other.

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The foregoing, if I may be allowed the term, may be taken as an epitome or definition of the science of Anthropology, and will serve as a fitting introduction to a few remarks on that subject, to the study of which in all its features Anthropology devotes itself, viz., man. At the very outset it will be asked "What is man? Define this being or animal called Man." He has been styled "An Intelligence assisted by organs." Such was the definition of a very profound thinker, Cardinal de Bonald, and this would be a very exact definition could it be exclusively applied to man, since it reflects his great characteristic feature, intelligence; but animals may be regarded as "*Intelligences assisted by organs*,"—they, too, possess an intelligence which prompts them in their necessities, but although man is an animal covered by an envelope which is common to all mammalia, yet he is superior to, and far surpasses, the lower creatures in intelligence and perfection of bodily formation. Figuier, a naturalist of the French school, defines man as "An organised intelligent being endowed with the faculty of abstraction" ("Human Race," p. 1); and another writer* styles him the noblest of all earthly creatures, standing related on the one hand through his body to the world of matter, on the other through his mind to the world of spirit, or nether world; at the verge of the animal kingdom most remote from its point of contact with the kingdom of organic (?) life, yet an inhabitant of such other kingdom *of pure intelligence*. The above may be accepted as the most perfect definition of man, but as such are merely expressions of theory, and on that account liable to rejection, a perfectly accurate definition cannot be given, since that would presuppose a perfect knowledge, of which our understanding on this question of man is incapable.

The origin of man, or the genesis of species, so far as it relates to man, becomes then one of the most interesting points which can entertain our powers of observation and investigation. Opposing scientific views and religious beliefs, and the conceptions of opposite philosophers, by a continual and increasing conflict, tend to evolve a comprehensive view of the origin of species, which will eventually harmonise them with one another; and when this comes to be finally established it will be one of the greatest benefits which can possibly be bestowed, as diverting the energy so often expended in useless controversy into a profitable and reciprocal channel, of mutual benefit to all. In the theory of the

* "Man," in Encyclopædia Brit.

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"Evolution of Man," as set forth by the author of the "Origin of Species," although it may have points of question at the present moment trenchant thereon, there is nothing which can eventually make it antagonistic to sound Christian theology. The evolution theory has during these later times been making a steady progress and gaining ground. Within the next few years, there is not the slightest doubt, the facts touching on this august question will be greatly augmented. The points at issue will be reconciled, and those now deemed untenable will not improbably find further evidence to support them, the results of which will be to firmly fix this theory, as I have previously noted, on a basis at once compatible with scientific belief and sound Christian theology.

Amongst the principles of evolution we find one enunciating that every individual has to undergo a severe struggle for existence, owing to the tendency to a geometrical rate of increase of all kinds of animals and plants, the consequence of which is that every variation of a kind tending to save the life of the individual possessing it, or enabling it more surely to propagate its kind, will eventually be preserved, and will transmit its peculiarity to the offspring; which peculiarity will, in its transmission, become more intensified until it arrives at the maximum degree of utility. (See Mivart's "Genesis of Species," pp. 5-6.)

In this proposition we have a line to follow in our search for the "Origin of man," and there does not appear any great difficulty in arriving at the conclusion of the evolving of man from an inferior creature. The writer of the "Origin of Species" speaks of "life with its several powers having been originally breathed by the Creator into a few forms or ova,"* and it must be conceded that Creation is not what many who are ignorant of the effect of natural laws regard it, a series of cataclysms and miraculous interferences with the laws of Nature, during which some new form of life is belched into existence, but the very institution and working of those laws; for law and regularity, not arbitrary intervention, was the true patristic ideal of Nature. Hence, as Creation is the progress and fulfilment of the laws of Nature in the course laid down by the Creator, and the law of evolution leads to the existence of the fittest, it may be assumed that the Creator having the great object —the creation of man—in view from the beginning, ordains that these laws of Nature, so set in motion by His omnipotent

* "Origin of Species," Fifth Edition, 1869, p. 579.

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power and omniscient will, shall act in such manner as to evolve and perfect from the lower creations a being whose progression to perfection shall be in such a delicate gradient, that it shall be impossible for the human understanding to point out where the animal ceases and man begins.

(To be continued.)

THE FLORA OF WARWICKSHIRE.

AN ACCOUNT OF THE FLOWERING PLANTS AND FERNS OF THE COUNTY OF WARWICK.

BY JAMES E. BAGNALL, A.L.S.

(Continued from page 268.)

CRYPTOGAMIA.

ACOTYLEDONS.

FILICES.

PTERIS.

P. aquilina, *Linn. Brake or Bracken.*
Native: On heaths, hedge banks, and woods. Very common. June, July. Area general.

LOMARIA.

L. spicant, *Desv. Hard Fern.*
Native: In woods and on damp banks. Local.
I. In lanes about Aston Park, *With., Ed.* iv., 750 (extinct); Coleshill Bog! *Ick. Anal.*, 1837; Sutton Park; Trickley Coppice; New Park and other Middleton woods; Bentley Park; Hartshill Hayes; Coleshill Heath; Marston Green; woods near Solihull; Olton Reservoir; Monk's Path, near Shirley; Windmill Naps, Little Ladbrook.
II. Heathy places on Honiley Common! *Baynes*; Haseley Common, *Perry, Phyt.* i., 510; Stoke Heath Woods, *T. K., Phyt.* ii., 810; Fern Hill! *Y. and B.;* near Wolston Heath, *H. W. T., R. S. R.*, 1874; very fine and abundant in Haywoods.

ASPLENIUM.

A. Ruta-muraria, *Linn. Rue-leaved Spleenwort.*
Native: On old walls and ruins. Local. June to October.
I. Aston Park Wall! *Ick. Anal.*, 1837; Bickenhill Church! Maxtoke Castle! *W. T. Bree, Phyt.* i., 511; ruins of Nuneaton Abbey! *T. K., Phyt.* ii., 810; old walls about Dosthill; old walls, Ansley; near Curdworth Bridge; Water Orton Bridge; bridge near Castle Bromwich; bridge at Elmdon; old walls, Mancetter abundant; old walls, Wilnecote, near Tamworth.

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II. Church porch at Great Alne; Walcot; Wixford, *Purt.* ii., 513; Tachbrook and Kenilworth Churches, *Perry Fl.* 84; Allesley; Stoneleigh, *W. T. Bree;* Southam Church! *W. W. Baynes;* St. Mary's Church-yard Wall, Warwick, *W. G. Perry;* Tachbrook Church; *Murcott*; Vicarage and Priory Walls, Warwick; Coventry Town Wall, *J. S. Baly, Phyt.* i., 511; on wall of park at Watford, *L. C., R. S. R.*, 1874; walls, Wootton Wawen, abundant; bridge near Shrewley Canal Tunnel; bridge, Atherstone-on-Stour.

A. Trichomanes, *Linn.* *Common Spleenwort.*

Native: On old walls and ruins. Rare. June to October.

I. Elmdon Hall, near Hockley, *W. Southall, Phyt.* ii., 511; Maxtoke Priory; Coleshill; bridge over the River Cole, near Coleshill; near Knowle; railway bridge near Solihull; old bridge, near Mancetter.

II. On Coughton Church; Walcot, *Purt.* ii., 514; walls at Kenilworth Castle, *Perry Fl.*, 84; Allesley; Stoneleigh, *W. T. Bree;* church porch, Stratford-on-Avon, *W. G. Perry;* Newbold, *R.S.R.*, 1880; bridge over the Avon, Stratford-on-Abon, *J. Humphreys.*

A. Adiantum-nigrum, *Linn.* *Black Spleenwort.*

Native: On old walls and dry shady banks. Rare. April to October.

I. Maxtoke Priory, *J. S. Baly, Phyt.*, ii., 511; Meriden, Balsall, *Bree, Phyt.*, i., 511; in a lane near Berkswell; lane between Meriden and Hollyberry End, *Kirk, Phyt.*, ii., 810; marly banks, near Knowle; Damson Lane, Solihull.

II. Sambourne; Middletown; Oversley, *Purt.*, ii., 512; walls at Kenilworth Castle; stone quarry, Coton End, Warwick; on Emscote Bridge, *Perry Fl.*, 84; common in the parish of Corley; Allesley, *W. T. Bree;* rocky bank below Milverton, *Baynes;* between Hampton-on-the-Hill and Norton Lindsay; Fen End, *Perry;* on a bank near Henley; on the church at Henley, *Murcott;* Norton Hill, *Baly, Phyt.*, ii., 511; on a bridge at Binley, *Kirk, Phyt.*, ii., 809; in a ditch near the Blue Boar; on old walls near Little Lawford Mill, *R. S. R.*, 1874; old walls in the village of Haslor; on old bridge near Henley-in-Arden.

ATHYRIUM.

A. Filix-fœmina, *Bernh.* *Lady Fern.*

Native: Near streams, ditches, and in damp woods, copses and other damp places. Locally abundant. June to September.

I. Coleshill, *Bree, Purt.*, iii., 79; Bannersley Common and Wood! moist bank near to Stonebridge! *Murcott;* in a lane near Sutton Park, *Cameron, Phyt.*, i., 511; Sutton Park; Middleton Heath; Trickley Coppice; New Park and Middleton Park; Marston Green; near Knowle and Solihull; Bentley Park; Poors Wood and Blackhill Wood, Honiley.

II. Allesley, *Bree, Purt.*, iii., 79; between Leamington and Kenilworth! *Baynes;* on the porch of the church, Stratford-on-Avon, *Perry, Phyt.*, i.. 511; Oversley Wood; Haywoods, &c.

Var. *rhæticum*, Roth.

I. Sutton Park; near Ashfurlong House; Trickley Coppice; New Park; Marston Green; Meriden Shafts; Hartshill Hayes; Bentley Park; Blackhill Wood, Honiley.

II. Boggy places, near Binley; Stoke Heath; Deer Park, Arbury, *T. Kirk, Phyt.*, ii., 809; Fern Hill! *Y. and B.;* Haywoods.

Var. *molle*, Roth.

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II. Arbury Deer Park, *T. Kirk*, *Phyt.*, ii., 809; Haywoods, 1871.

The varieties of this species have not been sufficiently noticed to allow me to assign each variety to its particular locality. I have only localised the varieties where special notice of them has been recorded by other observers, or where special notice of them occurs in my own note-book.

Var. *incisum*. Crackley Wood, *Y. and B.*

CETERACH.

C. officinarum, *Willd.* *Scaly Spleenwort.*

Alien: On old walls near gardens. Very rare. May.

I. On old walls, near Atherstone, *G. T. Harris!*

II. Walcot, in Haslor parish, *Purt.*, ii., 517; on a brick wall at the back of the mansion house, Tachbrook, *Perry*, *Phyt.*, i., 511; Wall of Lancastrian Yard, Coventry, *Kirk*, *Phyt.*, ii., 809; old wall, near Birdingbury Hall, *H.B.*

SCOLOPENDRIUM.

S. vulgare, *Syme.* *Hart's Tongue.*

Native: On damp shady and marly banks and old walls. Rare. June to August.

I. Knowle! *W. Southall;* damp shady places near Elmdon, *D. Cameron;* boggy ground near Solihull, *Mr. Ick*, *Phyt.* i., 511; damp banks, Marston Green; near Hampton-in-Arden; on an old bridge near Knowle.

II. In a ditch by the side of the footpath from Warwick to Hampton-on-the-Hill, *Perry Fl.* 85; plentiful at Hatton Rock, near Stratford; Kenilworth, near the ruins; bank of a pool at the Woodloes; roadside between Budbrook and Hampton-on-the-Hill, *Murcott;* Tachbrook, *Baly*, *Phyt.* i., 511; in Princethorpe village, *Blox. M.S. note;* Lighthorn village, *H.B.*; on marly and damp banks near Claverdon; and near Holywell.

Formerly abundant in many of these localities, but now eradicated in most of them.

CYSTOPTERIS.

C. fragilis, *Bernh.* *Brittle Bladder Fern.*

Alien: On old walls. Very rare. June to August.

II. Near Arbury Hall, *T. Kirk*, *Phyt.* ii., 972; Guy's Cliff, near Warwick! *T. F. Foster, jun.*, *Herb. Brit. Mus.*, 1849; near Guy's Cave, Guy's Cliff, 1877, an escape probably; Compton Verney, *D. Cameron*, *Phyt.* i., 510.

ASPIDIUM.

A. aculeatum, *Sw.* *Common Prickly Shield Fern.*

Native: on hedge banks. Local. June to September.

I. In a ditch near Elmdon, *With.*, ed. 4, 761. Abundant near New Park, Middleton; Middleton Heath; banks, near Nether Whitacre, Shustoke, and Maxtoke; Islington, near Kingsbury; banks near Hartshill and Arley; banks near Fillongley and Meriden Shafts; banks near Knowle and Solihull; lanes near Baddesley Ensor.

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II. Pinley! Rowington! *Y. and B.;* near Barby; Blue Boar Lane; roadside between Long Lawford and Little Lawford Mill! *R. S. R.* 1877; Dilke's Lane, near Kingswood; Lapworth, Holywell, Claverdon, &c.

b. lobatum.

I. Saltley, *Ick, Anal.*, 1837; near Packington, *Smith, Perry Fl.*, 83; Elmdon! and near Castle Bromwich, *Cameron;* near Maxtoke! *Luxford, Phyt.*, i., 510; Four Oaks, near Sutton; Middleton Heath; lane near Islington and Baddesley Ensor; lanes near Arley; lanes near Shustoke.

II. In a wet lane at Studley; Sambourne; Oversley! *Purt.*, ii., 509. About Warwick, *Perry Fl.*, 83; thicket between Huningham and Offchurch; on the road from Warwick to Henley, *Murcott;* Allesley! *Baly, Phyt.*, i., 510; Pinley! *Y. and B.;* Hampton-on-the-Hill, *H. B.;* Stoneleigh; Hollyberry End! Wyken Lane! *T. Kirk, Phyt.*, ii., 809; near Kingswood.

c. lonchitidioides.

II. Near Stoneleigh; Meriden, *Kirk, Phyt.*, ii., 809: near Hatton! *H. B.* Merely an abnormal growth.

A. angulare. *Willd. Angular-lobed Shield Fern.*

Native: On hedge banks. Local. June to September.

I. Elmdon! and near Castle Bromwich, *Cameron, Phyt.* i., 510; Middleton Heath; near Fillongley and Maxtoke; near Meriden Shafts; Bentley Heath, near Solihull.

II. Rare near Warwick, *Perry;* Radford; ditch at the top of Emscote Hill, opposite the turn to Milverton, *Baly, Phyt.* i., 510; near Stoneleigh; near Berkswell! Hollyberry End! Stivichall; Whitmore Park; Hearsal Common, *Kirk Phyt.* ii., 809; near Hawkes End, Allesley.

NEPHRODIUM.

N. Filix-mas, *Rich. Male Fern.*

Native: On hedge banks, in woods, and bushy places. Common as an aggregate species. June to August. Area general.

b. affine, Fisch. Local.

I. Trickley Coppice; New Park; Middleton Heath; Austrey, near Tamworth; Shustoke; Hill Bickenhill; lane near Meriden Shafts; Hazel Hill Wood, Honiley; &c.

II. Bearley and Snitterfield Bushes; Austey Wood; Wootton Wawen; Oversley Wood; Old Park Wood, Ragley, &c.

c. Borreri, Newm. Local.

I. Middleton Heath; Trickley Coppice; New Park; Hill Bickenhill; Great Packington; lane near Fillongley and Maxtoke; Black Hill Wood, Honiley.

II. All Oaks Wood, Cathiron Lane, Brinklow.

d. abbreviatum, DC. Very rare.

II. Oversley Wood.

N. spinulosum, *Desv. Narrow Prickly-toothed Fern.*

Native: On damp banks and in damp or marshy woods and copses. Local. June to August.

I. Coleshill Heath! Frogmore Coppice, near Temple Balsall, *Murcott, Phyt.*, i., 510; Sutton Park; Trickley Coppice and New Park, Middleton; Kingsbury Wood; Bentley Park; Hartshill Hayes; Arley Wood; Bannersley Rough; marsh near Packington; copses in Wheyporridge Lane, Solihull; Shelly Coppice; woods near Sharman's Cross; Blackhill Wood, Honiley; Windmill Naps, Little Ladbrook.

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II. Allesley, *Bree*, *Purt.*, iii., 81; Chesterton Wood, *Perry;* Waverley Wood, near Weston, *Murcott*, *Phyt.*, i., 510; Haywood! *Y. and B.* In boggy places near Binley; North Wood, Arbury Hall! *Kirk*, *Phyt.*, ii., 807: near Rugby, *A. Blox.*, *Herb. Brit. Mus.* Oversley Wood; Newlands Wood, Hatton; Plants Hill Wood, near Tile Hill; Austey Wood, near Henley-in-Arden; Bearley, and Snitterfield Bushes.

N. dilatatum, *Desv. Broad Prickly-toothed Fern.*

Native: In woods and copses, and on banks. Locally commor. June to August.

I. Sutton Park; Middleton Heath; Trickley Coppice; New Park; Bentley Park; Hartshill Hayes; Bannersley Pool and Rough; woods about Solihull; banks near Knowle and Hockley; Hazel Hill Wood, Honiley; Windmill Naps, Little Ladbrook.

II. Coughton Lane and Spernall, *Purt.;* Allesley, *Bree*, *Purt.* iii., 80; Oakley Wood; rocks below Milverton, by the Avon, *Baynes;* Woodloes, *Perry;* Foleshill, *Baly*, *Phyt.* i., 510; Stoke Heath, sparingly! Stivichall, Whitly Common; plentiful and very fine North and other woods in Arbury Park! *Kirk*, *Phyt.* ii., 809; Lower Hillmorton Road, Blue Boar Lane! lane near Bilton, *R. S. R.*, 1877; Honiley; Fernhill! *Y. and B.;* Oversley Wood; Bearley Bushes; Haywoods; woods near Tile Hill; Combe Woods.

N. Thelypteris, *Desv.*

Native: In marshes and bogs. Very rare. July, August.

I. Sutton Park.

II. In a boggy pit, Allesley, *Bree. Mag. Nat. Hist.* iii., 166; in a pit near Rounsell Lane, Kenilworth, *H.B.;* I believe exterminated in both localities now.

N. Oreopteris, *Desv. Sweet Mountain Fern.*

Native: In woods, copses, on banks, and near streams. Rare. June to September.

I. Coleshill Heath, plentiful! *Bree. Phyt.* i., 510, rare in this locality now; in a lane near the Bell Lane at Erdington, *With.*, *Ed.* 7, 995; near Atherstone, abundant, *G. J. Harris;* Sutton Park, formerly abundant by many of the streams; Middleton Heath; Trickley Coppice, Middleton; Bannersley; Marston Green; Windmill Naps, Little Ladbrook.

II. Corley, *Bree. Purt.* ii., 508; Dunsmore Heath, near Rugby, *Doody in R. S.*, *Perry Fl.*, 83; Haseley Common, *Perry*, *Phyt.* i., 510.

(To be continued.)

Review.

Spectrum Analysis. By Dr. H. SCHELLEN; translated by JANE and CAROLINE LASSELL; edited by Capt. ABNEY. Second edition, 8vo., 626 pp., 14 plates, 291 woodcuts; price 31s. 6d. Publishers, Longman and Co.

ALL students of science will welcome this new edition of Dr. Schellen's excellent book. It is divided into eight parts, treating respectively of the artificial sources of high degrees of heat and light; the application of spectrum analysis to terrestrial substances; to the examination of the sun; of the moon and fixed stars; nebulæ and star-clusters; comets and meteors; the zodiacal light, aurora borealis, and lightning. In the early chapters, the principles of light,

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the construction of the spectroscope, and the history of the discoveries which have been made by its aid are dealt with in the fullest and clearest manner. Throughout the book each chapter contains the latest reliable information on the subject of which it treats, and this is so put together, and the facts are so skilfully handled and massed, that the book, as a whole, is far more easy to understand than many an elementary text-book. The Misses Lassell have so translated the book that we cannot detect that it *is* a translation, while Capt. Abney's own researches in this subject have enabled him to render valuable aid as editor. The illustrations are extremely satisfactory, such, alas, as we only find in scientific books of foreign origin. The frontispiece, however, a Woodburytype reproduction of Mr. Common's magnificent photograph of the great nebula in Orion, we are proud to claim as of English origin throughout. As the most complete and exhaustive work on the subject, this book ought to be in every library. It does great credit to all who have been engaged in its production.

W. J. H.

METEOROLOGICAL NOTES.—August, 1885.

Atmospheric pressure was unsteady during the month, the barometer falling, with slight checks, to the 10th, when the reading was 29·563 inches. A rapid rise followed to the 15th, 30·350 inches, and unimportant fluctuations continued till the end of the month. Temperature was about four degrees below the average, lower in fact than that of any of the previous nine years, the deficiency being more especially noticeable in the maximum readings. The highest recorded were 78·5° at Henley-in-Arden, on the 17th; 76·0° at Loughborough, on the 25th; 74·8° at Hodsock, and 74·0° at Strelley, on the 16th. In the rays of the sun, 133·9° at Loughborough, on the 15th; 128·8° at Hodsock, on the 6th; and 125·0 at Strelley, on the 10th. The lowest minima were 35·0° at Henley-in-Arden, on the 14th; 36·3° at Hodsock, 36·6° at Strelley, and 37·9° at Loughborough, on the 15th. On the grass the mercury fell to 29·0° at Hodsock, 35·0° at Strelley, and 35·4° at Loughborough, also on the 15th. Rainfall was somewhat above the average, heavy showers being the principal factors in the total. The largest amounts measured were 0·78 inches at Loughborough, on the 21st; 0·66 at Hodsock, on the 7th; 0·56 at Henley-in-Arden, on the 12th, and 0·47 at Strelley, on the 6th. The total values were:— Henley-in-Arden, 2·90 inches; Loughborough, 2·83 inches; Hodsock, 2·58 inches; Strelley, 2·02 inches. The number of "rainy days" varied from 13 to 10. Sunshine was much below the average. Thunderstorms occurred at Loughborough on the 6th and 7th. There was every prospect of an early harvest, but field operations have been much retarded by the unsettled state of the weather.

Wm. Berridge, F.R.Met.Soc.

12, Victoria Street, Loughborough.

Natural History Notes.

Death's Head Hawk Moth.—The larvæ of *Acherontia atropos* have occurred here (North Leicestershire) in some numbers during the last few weeks, the first seen for a number of years. The specimens found were scattered through this district in localities many miles

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apart. Nearly all were found feeding on the potato, but two were sent me from Leicester, which had been found feeding on the plant commonly called tea tree; and on the 5th September, I obtained one of three which were feeding on the privet, a food-plant not hitherto recorded, I believe, for the larva of atropos. Mr. J. B. Wieldt, F.Sc.S., informs me that till this year he has only seen one specimen here for fifteen years.—WILFRED MOSS, The White House, Loughborough.

THE WEAPONS OF BUTTERFLIES.—Having recently read a paper on "The Weapons of Animals," I was much interested this morning to observe how a butterfly is armed for the defence of his rights and the robbing of his neighbours. On the disk of a sunflower there sat a bumble bee, a hive bee, and two large flies (*diptera* apparently), all regaling themselves in peace and amity. A fine red admiral hovering by took a fancy to the same sunflower, and settled in the middle of it, flapping vigorously his great handsome wings. The bees and the flies edged away towards the margin, but he continued to flap till they were fairly driven off and he had the field to himself. Then he worked diligently over it, trying every floret with his long bent proboscis. The bees and the flies made several attempts to return, but as soon as they came within sight or touch, flap went the great wings, and away they flew as if they were frightened. The admiral kept the place entirely free from intruders for nearly five minutes, when he took himself off to "pastures new." F. T. MOTT.

AREGMA BULBOSUM.—It has occasionally been asked whether the above fungus is as common as Dr. Cooke reports it to be, for it has been carefully sought in this district for the last year or two with little success. At the present time it may be found abundantly in the neighbourhood of Bewdley, quite justifying Dr. Cooke's observation of "very common." I noticed that for the distance of perhaps a mile nearly every bush was more or less attacked by it. For the microscope this object mounts well in glycerine or balsam, and is very interesting. If any reader would like a leaf I shall be pleased to forward one on receipt of stamped envelope.—J. W. NEVILLE, Wellington Road, Handsworth.

[It is quite true that *Phragmidium bulbosum* scarcely merits the name of a "very common" species in this neighbourhood, for it is extremely local and irregular in its appearance, although where it does occur it is often in great abundance. The same is equally true, however, of most of the "common" species of leaf-fungi, not only for this neighbourhood, but, I believe, for many others. *Xenodochus carbonarius*, again, is a rare species, yet in the only locality near here where I have seen it (Water Orton), it grows in such great profusion that, both in 1883 and 1884, I could, if required, have gathered several thousands of affected plants. I have seen *P. bulbosum* in large quantities near Solihull, and near Kenilworth, besides other places; at the former place the bushes along the roadside for some distance appeared as if sprinkled with red paint, owing to the conspicuous blotches upon the leaves. This was in 1883. It is necessary, however, to state that the *Phragmidium bulbosum* of Cooke's works (*Aregma bulbosum* of the older editions, a name now obsolete) includes two species:—*P. violaceum* and *P. Rubi*, the distinguishing characters of which may be found in the "Midland Naturalist" for 1883, p. 21. It is of the former that I speak, *P. Rubi* being more rare here. I have seen no specimen of the latter from this neighbourhood. *Phragmidium obtusum* is the most common species, being always to be found by a little searching; *P. mucronatum* is more rare; and the rarest of all the Phragmidia of this

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district, so far as I know, is *P. gracile*, on the wild raspberry. On Saturday last (Sept. 19th) I saw several bushes attacked by *P. violaceum*, near Barnt Green Station.—W. B. GROVE, B.A.]

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—GENERAL MEETING, September 1st, the President in the chair, Mr. W. B. Grove exhibited the following fungi:— *Hypocopra microspora* (new to England, previously recorded from Scotland, which has been hitherto the only known locality), and *Zignoëlla pulviscula*, from Edgbaston; *Leptosphæria Rusci* (on *Ruscus aculeatus* and on *R. Hypoglossum*) and *Leptothyrium Fragariæ*, from Sutton; *Trematosphæria pertusa*, from Barnt Green Reservoir; *Rhabdospora pleosporoides* (new to Great Britain) on stems of sorrel, taken from a nest of the common tern, which had been received by the President, Mr. R. W. Chase, from the West Wide Opens, one of the Farne Islands; mounted specimens of the spores of the Hypocopra and the Rhabdospora, for the microscope; also (on behalf of Mr. J. W. Oliver) a few plants sent by an old member, Mr. J. W. Pickering, from Victoria, Australia—two sundews, *Drosera Whitackeri*, and *D. glandulifera*, each about 1½ inch in total height, and the former bearing one or more scapes, each with a single flower one inch across; and two orchids, *Caladenia deformis* and *C. pulcherrima* (spider plant). Mr. T. Bolton exhibited *Microcodon clavus*, a rare rotifer, from Coleshill Pool. Mr. J. Levick exhibited *Cordylophora lacustris*, from Hamstead Canal, and *Stephanoceros Eichhornii*, from Alvechurch. Miss Browett exhibited *Himanthalia lorea*, from the Brig, Filey. Mr. G. M. Iliff exhibited some excellent micro-photographs of Echinus spines. BIOLOGICAL SECTION, September 8th.—Mr. W. R. Hughes, F.L.S., in the chair.—Mr. W. H. Wilkinson exhibited ripe fruit of the Lawton blackberry, grown from plants received from America. A proliferous state of the white clover, *Trifolium repens*; a leaf 3ft. 6in. long of *Dimorphanthus mandghuricus*, one of the ivy tribe. Mr. J. E. Bagnall, A.L.S., *Carduus eriophorus*, woolly thistle; *Serratula tinctoria*, saw-wort; *Arctium majus*, great burdock; *Clematis Vitalba*, virgin's bower; *Chlora perfoliata*, yellow centuary; and other rare plants, and a fungus, *Panus torulosus*, new to South Warwickshire, all from the Stratford-on-Avon district.—GENERAL MEETING, September 15th. Mr. T. Bolton exhibited the spermatophores of the cuttle-fish, from Cornwall. Mr. W. B. Grove exhibited two eatable fungi:—(for Mr. C. E. Robinson) *Agaricus ostreatus*, the oyster mushroom, on a cherry log, from Legge Lane, Birmingham; and (for Mr. Edmonds) *Coprinus comatus*, from Hockley. Miss Taunton exhibited *Acanthus spinosus*, from Dorset, a plant whose leaf suggested the original idea of the Corinthian capital. Mr. W. R. Hughes exhibited (for Mr. C. Parsons) a specimen of *Sagartia* which showed the process known as spontaneous generation or "fissiparity," *i.e.*, two discs with mouths and tentacles appearing on a single column.—GEOLOGICAL SECTION, September 22nd. Mr. T. H. Waller in the chair. Mr. T. H. Waller exhibited sections of quartzite, from the Ercal Hill, Wrekin; basalt, from Shatterford, showing vein of orthoclase; Whinsill, from Holwick Scar, Teesdale. Mr. J. E. Bagnall, *Sparganium neglectum*, new to Warwickshire; for Mr. W. B. Stone, *Sedum album*, showing a remarkable instance of vitality, the plant having been gathered in leaf in April, at Lake Como, had been laid aside on study

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table, and had flowered and fruited after being pressed; *Hypnum scorpioides* and other mosses, from Dartmoor; for Mr. Hughes, *Echinops paniculata*, with notes on its structure; for Mr. Henry Groves, *Malaxis paludosa*, from Norfolk. Mr. Grove, a flower of Stapelia, a "carrion plant," so called on account of the carrion-like odour given off by the flowers. Mr. Herbert G. Young, *Colchicum autumnale*, from banks of River Tame, at Great Barr. Mr. James Simkins, Lias limestone, found in tunnel of West Suburban Railway between Church Road and New Street Station, containing *Ostrea Liassica*.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—August 24th.—Mr. Moore exhibited specimens of *Pupa umbilicata* var. *alba*, and *Helix rupestris* from the Isle of Man, also diminutive specimens of *Limnæa stagnalis*, three years old; Mr. Hawkes, the following fungi:—*Melampsora tremulæ* on Populus tremula, *Puccinia violarum*, and *Aregma mucronatum;* Mr. Dunn exhibited on behalf of Mr. J. Baxter a series of objects illustrating the life-history of the lady-bird, coccinella, comprising the egg, larva, pupa, and imago; also a specimen of musk beetle, *Aromia moschata*. A paper was then read by Mr. H. Insley on "Bye-paths in Geology." The writer regretted the too frequent habit of students of Natural History neglecting ordinary or commonplace facts, and proceeded to show the great neglect of physical facts in geology by the majority of students. The phenomena of unconformability, dislocation, and denudation were described, and their importance urged upon the attention of those studying the subject. Local examples were given, and their evidence regarding past conditions of the district dwelt upon. August 31st.—Mr. Deakin, scattered cluster cups, *Æcidium depauperans* on *Viola cornuta;* Mr. Madison, a distorted specimen of *Planorbis nautileus* (the whorls being divided) from Trimpley; Mr. J. A. Grew, pupa of death's head moth, *Acherontia atropos;* Mr. Tylar, an African water bottle made of a gourd; Mr. Mulliss, silicified wood from Australia. Under the microscope Mr. J. W. Neville showed *Aregma bulbosum;* Mr. Mulliss, eggs of house fly. September 5th.—An excursion was made to Rowley Regis at the invitation of the president (Mr. C. Beale), to view his collection of objects relating to pre-historic man, etc. The collection consisted of numerous specimens of Palæolithic and Neolithic implements, comprising celts and other implements in flint, basalt, and serpentine, from roughly chipped to highly polished specimens, some with oblique and faceted edges, from various parts of Europe, the grave mounds of America, and South Sea Islands; also some exceedingly fine specimens of spear and arrow heads in flint, jasper, and chalcedony, and obsidian, some having serrated edges, from the base of the Apennines. Bronze implements were represented by arrow heads, knives, etc., of the Etruscan period. Mr. Beale described the objects in their proper order, and through Etruscan pottery, Samian ware, and early English pottery (of which specimens were shown), linked the remote past with more recent times. A most instructive afternoon was spent. September 7th.—Mr. J. Madison exhibited specimens of *Gryphea biloba* from Cheltenham; Mr. Hawkes, the following fungi:—*Puccinia striola*, *P. menthæ*, *P. valantiæ*, and *Coleosporium campanulæ;* Mr. Rodgers, a small collection of butterflies and shells from Bournemouth. Under the microscopes Mr. Moore showed palates of *Ancylus fluviatilis* and *Zonites crystallinus;* Mr. J. W. Neville, leaf of *Pinguicula vulgaris* with insects; Mr. Hawkes, a species of Myxomycetes. September 14th.—Mr. C. P. Neville exhibited specimens of starfish from Wales;

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Mr. Madison specimens of *Solen siliqua* and *S. ensis;* Mr. Hawkes, *Parnassia palustris;* Mr. Rodgers, an ichneumon fly, *Ophion luteum.* A paper was then read by Mr. W. Dunn on "Rotifers: their habits and habitats," in which he described a typical rotifer, and the views of early microscopists respecting them; the two kinds of rotifers—free swimming and fixed—the attachment of their eggs, their great fecundity, the general scarcity of males, and their modes of progression were severally dealt with, and types of the various kinds described. The paper, which was illustrated by diagrams, concluded by giving a few plain directions to their habitats, and the best modes of viewing them.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY.—SECTION D.—ZOOLOGY AND BOTANY.—Chairman, F. T. Mott, F.R.G.S.—Monthly meeting, Wednesday, September 16th. The Chairman reported that at the Field Day, on the 19th August, six members went to Brooksby Station, examined the River Wreake and the fields adjoining, and visited the prettily situated village of Hoby. In the river were found abundantly the water plants *Œnanthe fluviatilis, Potamogeton pectinatus, P. flabellatus, P. lucens, P. perfoliatus,* &c.; in the adjoining fields and on the river banks, *Tanacetum vulgare* and several other plants not hitherto recorded for that district. Also fifteen species of land and freshwater shells, including *Anodonta cygnea, A. anatina, Unio tumidus, Unio pictorum,* and *Dreissena polymorpha.* These five, the only species of large bivalves which inhabit the waters of the Midlands, were all taken together within one square yard. The Chairman proposed, as work for the Section during the autumn and winter, the preparation of a large number of drawings, magnified from three to twelve times, of the floral organs of various plants, both native and exotic. It would be a work of very considerable value and one in which the ladies could render great assistance. He presented a set of written instructions for the preparation of such drawings. Miss Catherine Hewitt was elected a member of the Section. Among the objects exhibited were some very fine specimens of *Anodonta* and *Unio,* dredged from the lake at Wistow Hall, one example of *A. cygnea* measuring six and a half inches in length; also specimens of the microscopic fungi, *Æcidium compositarum* and *Coleosporium tussilaginis,* on the leaves of the common colt's-foot, by Mr. Quilter. Several numbers of Cole's microscopic studies and slides, by Mr. Grundy. Fronds of the fern *Cystopteris bulbifera* bearing an abundance of its curious bulbils, by Mr. Thorp. Fruiting branch of *Rubus laciniatus,* the cut-leaved bramble, a variety which has been in cultivation for many years, being figured and described by Loudon in 1829, though rarely mentioned in more recent works, and which has lately been sold as an "American blackberry," by Miss Noble. A collection of thirty-five rare species of plants from Ben Lawers, by Mr. Carter, who promised a paper on the flora of that remarkable mountain. The fifteen species of shells collected by members of the Section at the last Field Day, cleaned and named; also a copy of Rimmer's "Land and Freshwater Shells of the British Isles," illustrated by photography, by the Chairman. The Chairman read a paper on "The Wild Geraniums of Leicestershire," explaining the distinguishing characters of the three genera, *Pelargonium, Geranium,* and *Erodium;* stating that out of about one hundred known species of *Geranium,* twelve were British, and that eight of these were found in Leicestershire, six being certainly indigenous. The paper was illustrated by dried specimens of all the British species.

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SOME FACTS ABOUT ARUMS.

We are all familiar with the fact that plants absorb and decompose carbonic acid, and that while keeping the carbon to build up their tissues, they restore nearly the whole of the oxygen to the air for the benefit of the animal world.

All this is true, but it is not the whole truth. Some plants—the whole race of fungi for instance—breathe as animals do, and exhale carbonic acid; and the tiny yeast plant, as it multiplies in the wort, produces carbonic acid in such quantities that the gas may be seen flowing over the sides of the beer-vat. Nor is even this all. *All* plants take up oxygen and give off carbonic acid, and that at all hours of the day and night, but especially at night; though the quantity given off is so small compared with that which is absorbed that it is apt to escape notice. Whether performed on a large or small scale, however, this giving off of carbonic acid is true breathing; it means that carbon has been oxidised or burnt, and therefore that more or less heat must have been produced. Yet plants, like frogs, are, with certain exceptions, always cooler than the surrounding air, owing to the constant evaporation or perspiration going on through the myriads of minute pores with which their leaves are studded. There are 120,000 pores in a square inch of lilac leaf; some leaves have 800 to the square inch, others 170,000; and through these water is constantly being perspired as invisible vapour. A single sunflower plant has been known to perspire as much as twenty-two ounces of water in the course of twenty-four hours; and thus, although some small amount of carbon is always being oxidised, the leaves are kept cool. Plants are especially active in giving off carbonic acid at certain times—namely, when they first begin to sprout from seed and when they blossom; and when a number of seeds are all sprouting together, as in the preparation of malt, the heat is quite sufficient to be noticeable.

If the bud of some large flower, such as a thistle or cucumber, be isolated under a bell-glass, when just on the point of expanding, it will be found that its temperature rises from a half to a whole degree centigrade ($1\frac{4}{5}$° F.) In many blossoms the heat is much greater than this, and is like that from a stove or a feverish hand. It is especially noticeable in plants of the arum tribe. We all know the common white arum, or "arum lily" as some people call it, with its large glossy leaves and snow-white sheath or "spathe" surrounding the golden sceptre-like column, which botanists call the "spadix."

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The true flowers are set round the base of this central column, what we call the blossom being in fact an assemblage of many blossoms, some of which are barren and some fertile. The fertile flowers bear pistils, and the barren stamens; and it is from the former, which are usually set lowest on the spadix, that the clusters of fruit are formed.

If the green sheath of the wild spotted arum or cuckoo-pint be wrapped in and filled with wadding to prevent the escape of the heat, the mercury in a thermometer placed close to the brown column will be found to rise several degrees.

The sudden increase of heat is more remarkable still in the heart-leaved arum of the Isle of Bourbon, whose temperature at blossoming time rises from twenty to twenty-four degrees centigrade above that of the surrounding air; and even this is outdone by the common Italian arum, which grows in the olive-yards, and is a familiar object to all who have enjoyed a Roman spring or spent a winter in the Riviera. This plant much resembles the cuckoo-pint, but its glossy dark leaves are larger and veined with yellow. The pale yellow sheath, which is stalkless, grows close to the ground, unfolds in March and April between 4 and 6 p.m., and emits a fragrant odour like that of wine, the temperature of the club-like column at the same time rising until it feels quite hot to the touch.

Professor Kraus found four of these arums near Rome one 28th of March, the temperature of whose blossoms varied from 40°C. to 43·7°C., that of the surrounding air being at the time 16°C.; 20°C. (68°F.) is a good summer heat, and 35°C. is blood heat, but these arum blossoms were hotter than a hot bath. This state of things did not last long, however, and by the following morning the sheaths had grown pale and wrinkled, the blossoms had passed their prime, and the heat had quite disappeared.

Interesting as these facts are in themselves, they become still more so when we consider them a little further, and ask what they mean. The older botanists, Humboldt included, had noticed the extraordinary degree of heat generated by some of the arum family, but there they stopped short, and the Italian, Delpino, seems to have been the first to suggest a reason for the phenomenon.

It is well known that in order to produce perfect seeds, most plants require to be fertilised by pollen brought from other plants of the same species. For this they are dependent upon wind, rain, birds, insects, &c., the two last mentioned being attracted to them by their bright colours or sweet scents.

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Now the arum family are not deficient in these customary attractions, but they seem to try and outbid their neighbours by adding warmth to the list. Most arums, in the temperate zones at least, blossom early in the year, when the nights are still so chilly that a comfortable well-warmed bed is by no means to be despised; and accordingly the common Italian arum is visited by all sorts of small flies, gnats, and midges, bringing with them in payment for their night's lodging a tribute of pollen from their last quarters.

Many South European and foreign arums are flesh-coloured or reddish brown, and emit such a carrion-like odour that the flesh-flies are attracted and so far deceived as to lay their eggs on them. In these species the lower part of the sheath, which is enlarged like a bulb, is shut off from the upper part by a ring of longish hairs which slope downwards, and thus, while affording easy entrance to the warm chamber below, make the leaving of it again an impossibility.

In return for bringing pollen to the pistil-flowers, the flies are caught and kept prisoners; but not for long—only, in fact, until the anthers or pouches of the stamen-flowers above have burst and scattered their pollen, part of which naturally falls upon the captives, while part is brushed off by them when they are let out. For as soon as they have fulfilled their object, the hairs at once wither away and the insects come out to carry the pollen to other blossoms, quite undeterred by the fact of their imprisonment, for the prison is in truth a most luxurious one, well warmed and scented; besides, they have been fed with nectar from the faded pistil-flowers. The hairy arum of the South is, however, said to express her gratitude to her pollen-bringing visitors by keeping and devouring the greater number, which are sucked and digested by the acid juice exuding from the hairs with which her sheath is lined.

But there are other guests for which a number of the aröids seem especially to prepare their warm lodgings; these are the little marsh snails, which climb up the stalk and find entrance into the enlarged part of the sheath by a narrow aperture at its base, which closes later on. Aröids all like a damp situation, and growing as they do in shady woods, on river banks, and in marshes, no creatures could be better adapted for rendering them the services they need than snails, whose tastes in this respect are so very similar to their own. Most of those observed by Delpino were visited by small snails, and we may reasonably suppose that the foreign varieties are equally attractive to the race in their own lands.

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One of the greenhouse aröids, *Philodendrum bipinnatifidum*, is a plant with handsome foliage, the leaves being deeply and doubly cut. Its sheath, which is greenish without and white within, swells into a cauldron-shape at the bottom, and in this cauldron is contained the ring of female or pistilliferous flowers, which, as in other species, are the first to open. In a specimen carefully watched by Dr. F. Ludwig, these flowers began to expand at noon, and at the same time the temperature of the air within the sheath began to rise and continued to do so until seven p.m. When the thermometer marked 38°C., and the heat was so great that it could be distinctly felt by the hand even at some distance, the temperature of the surrounding air was at this time only 15°C. As the flowers burst open a strong, fragrant scent, something between musk and cinnamon, filled the whole house; and this, in the plant's own country, would no doubt be well understood by the snails as a signal that their bed-chamber was comfortably heated and ready for their reception. By noon the following day both heat and fragrance were much diminished, and the aperture at the base of the sheath was entirely closed. When this closed, and not till then, the anthers of the upper ring of blossoms burst open and discharged their pollen, which hung about the spadix in tassel-like threads an inch long, instead of separating into dust in the more usual manner.

Now insects could not possibly carry these tassels, but they would adhere readily to the moist bodies of snails, and in contact with them would be broken up into single grains and thus easily carried away. And the snails must crawl up the sheath and come in contact with the pollen, because the door by which they entered at the bottom is now closed. Go they must, moreover, for their hostess has burnt carbon so liberally through the night that the cauldron is filled with carbonic acid, and they would be suffocated just as surely as the glowing match which Dr. Ludwig introduced was extinguished, if they stayed.

The plant has her own good reasons, moreover, for wishing to get rid of her visitors. Not only are their services required in carrying away the pollen, but if they stayed longer they might be dangerous, for snails are greedy creatures, and if not dismissed would begin to devour the young fruit-germs and other fleshy parts of the plant. Many aröids, indeed, allow their hungry guests to feed upon the sheaths, which soon cease to be required for the protection of the fruit; but in the great majority of species all the green portions are so virulently poisonous that not the smallest

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bite can be taken with impunity. Were it otherwise, indeed, the snail would naturally begin to devour the first leaf which came in its way without taking the trouble to climb the long stalk—an arduous journey for a small snail, which is only tempted upwards, like the boy who climbs a greasy pole, by the prospect of something very nice at the top. Having been regaled, however, with a delicious drop of nectar and made comfortable for the night, the snail at once departs, crawls up the sheath, brushing off pollen as it goes, then down the stalk, and without delay begins to mount another, just as other blossoms are announcing by their fragrance that they are in want of its services.

"And thus," as Carns Sterne, to whom we are indebted for most of the above facts, remarks, "the flowers receive the needful pollen by the fastest snail express."

SELINA GAYE.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

SOCIOLOGICAL SECTION.

At the opening meeting of the Sociological Section for the current session, held at the Mason College, on Thursday, 15th October, 1885, Mr. W. R. Hughes, F.L.S., the President, delivered a brief address, in which he alluded to the satisfactory progress of the Section, and to the number of accomplished masters and students of the respective sciences embraced in the "Synthetic Philosophy" who had kindly rendered assistance to the Section. The Section had systematically gone through Mr. Herbert Spencer's "Essays on Education," and it was now engaged in a critical examination of "The Principles of Biology" and "The Study of Sociology." Mr. Hughes also alluded to the gratifying fact that within the last few days Mr. Herbert Spencer had completed and published a third edition of the first volume of "The Principles of Sociology." The volume was specially interesting to the Section, as it contained a subject-index which had been prepared —as a labour of love—by Mr. F. Howard Collins, F.L.S., one of the members, and which could not fail to be most valuable to students. The volume had also a new appendix C, and it contained about 2,500 references to 455 works quoted therein. Mr. Hughes also announced that Part VI. of "The Principles of Sociology—Ecclesiastical Institutions" was in the press and would be published immediately,

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and he was quite sure that the members would all join with him in heartily congratulating Mr. Herbert Spencer on the steady progress of his great work, and hoping that he may live to see its completion. Mr. Hughes then said:

I venture here to take the liberty of correcting a misconception. I am quite sure that it is not necessary to do so to the members of this section, but it will give them the opportunity to make the correction in their circle, and my remarks may perhaps be reported publicly. In an address delivered by the retiring President of the Birmingham Philosophical Society to the members on this day last week he chose for his theme the extremely appropriate and well-timed subject, "The progress of the doctrine of Evolution." No one in Birmingham is in greater sympathy with this subject, and no one is capable of handling it from certain aspects more efficiently than my friend, Mr. Lawson Tait; moreover, he is not only an able but a generous-minded man, and a lover of fair play. I own I must confess to a considerable amount of surprise and regret at reading in the *Birmingham Daily Post* of the 9th instant a report of that address in these words, which I cannot pass unnoticed:—"His (Mr. Lawson Tait's) discourse consisted of an interesting review of the development of scientific knowledge during the last twenty-five years, and more especially of the manner in which corroboration had been furnished of the Darwinian theory of Evolution." It will be perceived that the above extract is in the third person, and therefore I am unavoidably prevented from using Mr. Lawson Tait's exact words, but I am open to correction if I have misread them, but I do not think I have; and moreover the subsequent matter reported in the *Daily Post* contains internal evidence that the above quotation from Mr. Lawson Tait's address is right in spirit if not in letter. What I take serious exception to is the omission of the mention of Mr. Herbert Spencer's name in connection with the doctrine of Evolution. His very existence is apparently ignored, for his name does not appear once in the newspaper report. I hope it may not be so when the address is published *in extenso*. Every student of Evolution knows, or should know, if he cares to have before him all the facts, that the illustrious Charles Darwin applied to animals and plants the hypothesis of the natural selection of favourable variations as the main *factor* in the *process* of *Organic* Evolution. On the other hand Mr. Herbert Spencer's formula of Evolution in general, expressed the transformation going on everywhere throughout the Cosmos; and he applied the ultimate physical laws by which the transformation is caused,

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to the interpretation of all progress—inorganic, organic, and superorganic. For the fullest evidence of the truth of my statement I turn to the twenty-ninth volume of the *Westminster Review* for the month of April, 1857, wherein appears an essay from the pen of Mr. Herbert Spencer, entitled "Progress: its Law and Cause," and at page 465 of that essay are these remarkable words:—

"We believe we have shown beyond question that that which the German physiologists have found to be the law of organic development is the law of all development. The advance from the simple to the complex, though a process of successive differentiations, is seen alike in the earliest changes of the universe to which we can reason our way back, and in the earliest changes which we can inductively establish; it is seen in the geologic and climatic evolution of the earth, and of every single organism on its surface; it is seen in the evolution of humanity, whether contemplated in the civilised individual or in the aggregation of races; it is seen in the evolution of society in respect both of its political and economical organisation; and it is seen in the evolution of all those endless concrete and abstract products of human activity which constitute the environment of our daily life. From the remotest past which science can fathom down to the novelties of yesterday, that in which progress essentially consists, is the transformation of the homogeneous into the heterogeneous."

It is, I conceive, not too much to maintain that the preceding words contain the whole "promise and potency" of the doctrine of Evolution. They are a *multum in parvo*, and an examination of this essay, which is reprinted (as revised) in Volume I. of Mr. Herbert Spencer's "Essays," will convince the most wavering sceptic of the truth of my assertion. Judge for yourselves, ladies and gentlemen, if the titles to the headings of the pages of this wonderful Essay, running from 445 to 485 inclusive, do not of themselves indicate its full scope and bearing. They are:—

The Nebular Hypothesis.
Physical Development of the Earth.
The Theory of a Biological Progression.
Evolution of Society.
Industrial Organisation.
Spoken and Written Language.
Painting and Sculpture.
Poetry, Music, and Dancing.
Development of Music.
Probability of a Common Cause.

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Exposition of the Cause.
The Cause Geologically Illustrated.
The Cause Illustrated in Physical Geography.
The Cause Illustrated in Chemistry.
The Cause Illustrated in Embryology.
The Cause Illustrated in Palæontology.
The Cause Illustrated in Social Evolution.
The Cause Illustrated in Science.
Concluding Reflections.

Ladies and gentlemen, you know very well, and the thousands of readers of Mr. Herbert Spencer both here and in America know very well, that these are the cardinal truths of the "Synthetic Philosophy" which Mr. Herbert Spencer has devoted his life-time to working out. One word more. You will have perceived that the date of Mr. Herbert Spencer's Essay is 1857, whereas Darwin's great work on the "Origin of Species" appeared in the year 1859, so that we are enabled with certainty to fix the date of the first promulgation of the idea of a comprehensive theory of Evolution at twenty-eight years ago, and not at twenty-five years ago as stated by Mr. Lawson Tait. It should further be noted that in the "Principles of Psychology," published so far back as 1855, Mr. Herbert Spencer interpreted the phenomena of mind, alike in all lower creatures and in man, as consequent upon processes of Evolution. Credit must, however, be given to many other workers in the same field, and the honoured names of Erasmus Darwin, Lamarck, Geoffroy St. Hilaire, Goëthe, Wolff, Von Baer, Henri Milne Edwardes, Robert Chambers, Professors Huxley and Haeckel, Alfred Russel Wallace, and others, must not be omitted as having contributed largely to the Biological cause, and the distinguished French philosopher, Auguste Comte, to the Sociological cause. Nevertheless it must ever remain an incontrovertible fact that Mr. Herbert Spencer was the first exponent to broach the doctrine of Evolution; and he is the only Englishman who has formulated a complete system of Synthetic philosophy showing its all-embracing scope.

Far be it from me to cast the faintest breath against the merits of the illustrious Darwin, who himself constantly quoted Mr. Herbert Spencer in support of his views, and spoke of him as "Our great philosopher." I perfectly agree with Mr. Alfred Russel Wallace that Darwin cannot be over-rated, and I also perfectly agree with Mr. Wallace in thinking that "If other principles should hereafter be discovered, or if it be proved that some of his subsidiary theories are wholly or partially erroneous, this very discovery

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can only be made by following in Darwin's steps, by adopting the method of research which he has taught us, and by largely using the rich stores of material which he has collected, but I am nevertheless a firm believer in the time-honoured proverb "Honour to whom honour is due," and I think I have made it clear that the theory of Evolution which Darwin applied to plants and animals Mr. Herbert Spencer applied, and applied previously too, to everything here and elsewhere. Listen to what Professor John Fiske, the eminent American philosopher and Spencerian, in a charming little book called "The Destiny of Man," published in 1884, says of both Darwin and Spencer. Speaking of one of Darwin's laws, known as "Natural Selection," he says: "Reckless of good and evil, it brings forth at once the mother's tender love for her infant and the horrible teeth of the ravening shark, and to its creative indifference the one is as good as the other." Of Spencer he says: "The greatest philosopher of modern times, the master and teacher of all who shall study the process of Evolution for many a day to come, holds that the conscious soul is not the product of a collocation of material particles, but is in the deepest sense a divine effluence. According to Mr. Herbert Spencer, the divine energy which is manifested throughout the knowable universe is the same energy that wells up in us as consciousness."

* * * *

"Our wills are ours, we know not how;
Our wills are ours, to make them thine.
Our little systems have their day;
They have their day and cease to be;
They are but broken lights of thee,
And thou, O Lord, art more than they."

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

PART I.

(Continued from page 281.)

Near to Chipping Warden there are two sections of the Marlstone; the one nearest the village showing about five feet of the rock-bed, with, at the top, some portions of the Transition-bed containing many gasteropods. The best section, however, in this neighbourhood is one situated about a mile from Chipping Warden towards Byfield. The Transition-bed here has yielded to the careful working of Mr. Walford a

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very large number of interesting fossils, but there is comparatively little to be done now. The list of fossils I give includes only those that I and Mr. W. D. Crick (who worked much of the district with me) have been able to procure.

Mr. Wilson's Pit, Chipping Warden.	Feet	In.
1.—Soil	1	0
Upper Lias.		
2.—Light-grey clay, containing small *ammonites* and *belemnites*, also irregular blocks of white limestone in the upper part—the remains of the Lower Cephalopoda-Bed	2	2
3.—Fish-Bed; a limestone in two bands, some of it violet coloured inside. Upper part in small irregular pieces, easily broken; lower part larger blocks, harder, and looks water worn in places; containing *Ammonites serpentinus, A. Holandrei, A. acutus, Euomphalus minutus, Fish remains, &c.*	0	3½
Middle Lias.		
4.—Transition-Bed; clay, and grey friable sandy marl, very red in places; the marl very fossiliferous, containing *Ammonites Holandrei, A. acutus, A. communis, Belemnites—several species, Chemnitzia foveolata, Cerithium ferreum, Alaria unispinosa, Eucyclus Gaudryanus, E. conspersus, Phasianella morencyana* (?) *or Phasianella Buvignieri* (?) *Cryptænia consobrina, Actæonina Ilminsterensis, Ostrea sportella, Pecten æquivalvis, Plicatula spinosa, Cucullæa Münsteri, Astarte subtetragona, Astarte striato-sulcata, Leda Galatea, Cardinia philea, Rhynchonella tetrahedra, Terebratula cornuta? Ditrypa etalensis, Diastopora liassica, &c.* ...	0	6
Small ironstone concretions and crystallised carbonate of lime in the lower part.		
5.—Ferruginous limestone similar to rock-bed. Lower part very fossiliferous—broken shells chiefly. *Large belemnites, Pecten liasinus, Pecten æquivalvis, Pentacrinus, Rhynchonella tetrahedra, var. Northamptonensis*	0	3
6.—Sandy marl, very much like the Transition-bed, but the fossils larger; the Rhynchonellæ mostly as separated valves. Many crushed specimens and broken shells, *Gasteropods, Encrinite stems, Rhynchonellæ, Bivalves*	0	3

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7.—Marlstone Rock-Bed, a ferruginous limestone, very red exterior, usual fossils.

The bed No. 5 is so nearly like the rock-bed that it is pretty evident it is formed of material arising from the denudation of some portion of the rock-bed near at hand, possibly no further away than Aston-le-Wall, because at this latter place there is distinct evidence of erosion. (See section below.)

Rectory Pit, Aston-le-Wall.

	Feet	In.
1.—Soil ... ... 1ft. to	1	6
Upper Lias.		
2.—Greyish clay, with remains of *Cephalopoda-bed* ...	1	7
3.—Fish-Bed, a whitish limestone, violet interior, containing a few *Ammonites* and *Belemnites*		
Middle Lias.		
4.—Transition-Bed, a rather hard limestone passing into No. 3, but easily recognised as the Transition-bed, containing *Ammonites acutus, Chemnitzia foveolata, Actæonina Ilminsterensis, Trochus, Plicatula spinosa, Encrinite stems, &c.*	0	6
5.—Clay or marl. In places this is absent, and its place entirely taken up by hard stone of the Transition-bed	0	1
6.—Marlstone Rock-Bed, top part crowded with broken and worn *Rhynchonellæ, Belemnites, Ossicles, &c.* ... ... about	6	0

The accumulation and packing together of broken shells at the top of the rock-bed here shows that it was, for a time at least, exposed to the action of moving water, either from actual exposure to the atmosphere, or from being sufficiently near the surface of the water to be affected by shallow currents or wave action.

About a hundred yards from the Rectory Pit just described, and nearly opposite the houses at Appletree, is a small section almost identical with the last, the grey clay No. 2 being a little thinner.

In the valley south of Byfield and near to Warden Grange is a small marlstone quarry which has not been worked for a long time. The section is as below.

Section near to Warden Grange.

	Feet	In.
1.—Soil, with blocks of limestone	1	3
2.—Light grey marly clay	2	9
3.—Hard white limestone, purple interior, *Ammonites* rather abundant, *Fucoid impressions*, &c. ...	0	4

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4.—Reddish sandy clay, passing downwards into a grey marl—the usual form of the Transition-bed. The upper part of the clay contained some badly-preserved fossils of a similar kind to those found in the marl 0 7

5.—Rock-bed.

I have already referred to the sections on the East and West Junction Railway as being about the best in the county for showing the sequence of beds from the lower part of the Upper Lias to nearly the base of the "*Margaritatus*" *Zone* of the Middle Lias. The several small cuttings extending from Byfield Railway Station to near Aston-le-Wall show successively lower beds, so that in order to verify the section given below it would be necessary to walk some mile and a half along the line.

Section on the East and West Junction Railway near to Byfield.

	Feet	In.
1.—Soil	—	
2.—Clay mixed with gravel, apparently unfossiliferous	3	0
"Communis" Beds—		
3.—Upper Cephalopoda-Bed; a flaggy limestone, whitish surface, violet interior, containing *Ammonites bifrons, A. Holandrei, Belemnites, Pectens, Astarte, &c.*	0	6
4.—Clay-Marl, breaks into somewhat cubical blocks, little white concretions very numerous, containing *Ammonites communis* (abundant), *A. bifrons, some small "falcifer" ammonites, Belemnites, Astarte, Pentacrinite joints*	3	0
"Serpentinus" Beds—		
5.—Lower Cephalopoda-Bed; a yellowish, hard, sandy limestone, dirty violet coloured interior, not flaggy, many small white concretions, containing *Ammonites serpentinus, A. exaratus, A. Holandrei, A. communis, A. Levisoni, Belemnites, Fucoid impressions*	0	9
6.—Light Coloured Marl, nearly white, not very homogeneous in composition, breaks into cubical masses, many white concretions, fossils very scarce	3	0
"Fish and Insect" Beds—		
7.—Shale, scarcely distinguishable from bed above in the section, containing *Flattened ammonites, Belemnites, Fish Scales*	0	1

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8.—Fish-Bed, somewhat nodular, nearly white exterior, dark purplish inside in places, not a continuous bed, containing *many "Planulate" ammonites, a few "Falcifer" ones, Belemnites, Euomphalus minatus, Fish fragments, Wood, &c.*	0	4
"Transition" Bed.		
A.—Layer of dark blue and red sandy clay, very much mixed up; no fossils noticed	0	3
A yellowish sandy limestone, rather soft, the fossils only casts, with here and there a harder piece from which a few fossils could be obtained. *Ammonites acutus, Macrodon, Gasteropods, &c.*	0	4
"Spinatus" Zone.		
B.—Rock-Bed, a sandy limestone, containing a good deal of iron, layers of *ossicles*, "Jacks," several irregular inconstant partings of red sand. Fossils in sandy part only casts. *Usual fossils, Waldheimia resupinata* rather abundant ...	6	0
C.—Marly Clay, containing concretionary ferruginous nodules	1	6
D.—Shaly Ferruginous Limestone, rather sandy, fossils fairly abundant. *Ostrea cymbium, Pecten liasinus, Limea acuticosta, Protocardium truncatum, &c.*	0	4
E.—Marly Clay, similar to "C."	2	7
"Margaritatus" Zone.		
F.—Sandy Ferruginous Limestone, rather soft and shaly, containing *Ammonites margaritatus* in abundance, *Pleuromya costata* (abundant), *Turbo aciculus, Ostrea cymbium* var. *obliquata, Plicatula spinosa, Inoceramus substriatus, Modiola numismalis, Cardita multicostata, &c.* (see p. 188)	3	2
G.—Sandy Marl, containing *Ammonites margaritatus, &c.*	6	2
H.—Soft Sandy Limestone, containing *Ammonites margaritatus, Pholadomya ambigua* in abundance, *Fucoid impressions, &c.* (see p. 187)	3	3

Beds 1 to 8, as also A and B, may be best examined near to Byfield, both along the line and in a small quarry on the south side of the line; D to H, best on the south side of the line near to Byfield Pool, though since the line has been put in working order again none of the beds below B can be well seen. I may add that I have never myself seen the soft beds C, E, and G, the description of them having been taken from Mr. Walford's pamphlet. Mr. Walford says that a hard

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shelly limestone containing *Cardita multicostata* was met with below, and this, I certainly think, would be "L" of the typical section. On one occasion I found a single block of stone on the line containing the following fossils:—*Cardita multicostata*, *Ostrea*, *Pecten æquivalvis*, *Protocardium truncatum*, *Cardinia antiqua*, *Cardinia lævis*, *Astarte striato-sulcata* (abundant), *Turbo* (near to *nudus*), *Serpulæ*, &c., and this I considered as being a part of the bed "L." There are several small "faults" in this neighbourhood; one not far from the station at Byfield can be traced across the line; also part of this, or another small one, may be seen in the quarry near at hand. Another is to be found just by the side of PRIOR'S MARSTON ROAD BRIDGE, the line of dislocation running N.E. by N. to S.W. by S. The beds of the Marlstone and Upper Lias here have a gentle dip westward, and the "fault" has only had the effect of altering the dip and position over a space of about twenty yards. Still another "fault" is found a little beyond Byfield Pool.

(To be continued.)

NOTES ON THE FLORA OF AMERICA,

MADE DURING A TOUR IN THE NORTH-EASTERN STATES IN APRIL, MAY, AND JUNE, 1882.

BY W. H. WILKINSON,

HON. SEC. BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

(Continued from page 276.)

AMERICAN PLANTS

COLLECTED IN APRIL, MAY, AND JUNE, 1882, BY W. H. WILKINSON.

Named and classified from the "American Botanist" of Alphonso Wood, A.M.

NATURAL ORDER, 1.—RANUNCULACEÆ.

Name.	Place where found.
Anemone parviflora.....	Catskill Creek, Hudson River.
Hepatica trilobata	Au Sable Chasm and Saratoga.
Thalictrum dioicum.....	St. Helen's Island, Montreal, Canada.
Ranunculus sceleratus ..	St. Helen's Island, Montreal, Canada.
,, recurvatus ..	Mount Royal, Montreal, Canada.
,, tomentosus ..	Fort McHenry, Baltimore.
,, palmatus	Central Park, Chicago.
Aquilegia Canadensis	St. Helen's Island, Montreal.
,, formosa	Rocks, Niagara Falls.
Actæa spicata	Islands, Niagara Falls, and St. Helen's Island, Montreal.

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NATURAL ORDER, 6.—BERBERIDACEÆ.

Podophyllum peltatum (May apple) ..... Fort McHenry, Baltimore.

NATURAL ORDER, 8.—SARRACENIACEÆ.

Sarracenia Gronovii..... Botanic Gardens, Washington.

NATURAL ORDER, 9.—PAPAVERACEÆ.

Sanguinaria Canadensis.. Island, Niagara Falls.

NATURAL ORDER, 10.—FUMARIACEÆ.

Dicentra cucullaria (White Ear-drop) ..... Island, Niagara Falls.

NATURAL ORDER, 11.—CRUCIFERÆ.

Arabis Canadensis ..... Fort William Henry, Lake George.
Cardamine laciniata..... Goat Island, Niagara Falls. Woods. Plentiful.
Sisymbrium canescens (Tansy Mustard).... Kingston, Canada.
Capsella Bursa-pastoris .. Fort McHenry, Baltimore.
Lepidium ruderale ..... Fort McHenry, Baltimore.
Lunaria rediviva ..... Niagara Falls, Canada.

NATURAL ORDER, 14.—VIOLACEÆ.

Viola pubescens..... St. Helen's Island, Montreal.
,, Canadensis ..... St. Helen's Island, Montreal.
,, palustris ..... St. Helen's Island, Montreal, and Clarke Hill Islands, Niagara Falls.
,, blanda ..... Au Sable Chasm, Cedar Island, Niagara Falls.

NATURAL ORDER, 17.—DROSERACEÆ.

Dionæa muscipula ..... Botanic Gardens, Washington.

NATURAL ORDER, 19.—CARYOPHYLLACEÆ.

Dianthus viscidus..... Washington Heights, New York.
Stellaria longipes..... Fort William Henry, Lake George.
Arenaria Canadensis .... Catskill, Hudson River.
,, rubra, var. Canadensis.
,, serpyllifolia .... Fort William Henry, Lake George.
Mœnchia quaternella (Weed) ..... Botanic Gardens, Washington.

NATURAL ORDER, 20.—PORTULACACEÆ.

Claytonia Virginica ..... Island, Niagara Falls.

NATURAL ORDER, 30.—GERANIACEÆ.

Oxalis stricta..... Saratoga, Lake George, Catskill, and Washington.
Geranium Robertianum.. Kingston, Lake Ontario, Canada.
,, maculatum.... Woodland Park, Saratoga.

NATURAL ORDER, 36.—ANACARDIACEÆ.

Rhus Cotinus..... Central Park, New York.

NATURAL ORDER, 37.—SAPINDACEÆ.

Acer saccharinum ..... Kingston, Ontario, and Washington.

NATURAL ORDER, 41.—VITACEÆ.

Vitis riparia ..... Cedar Island, Niagara Falls.

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NATURAL ORDER, 42.—POLYGALACEÆ.

Polygala Hookeri ..... Fort William Henry, Lake George.

NATURAL ORDER, 43.—LEGUMINOSÆ.

Melilotus officinalis ..... Boston and Baltimore.
Medicago lupulina ..... New York and Baltimore.
Trifolium agrarium ..... Catskill.

NATURAL ORDER, 44.—ROSACEÆ.

Rubus Canadensis ..... Kingston, Ontario, and Lake George.
„ hispidus (?) ..... Catskill, Hudson River.
„ trivialis..... Fort William Henry, Lake George.
„ simplex (?) ..... Fort William Henry, Lake George.
„ flagellans ..... Clarke Hill Island, Niagara Falls.
„ triflorus..... Caldwell, Lake George.
„ odoratus ..... Catskill, Hudson River.
Potentilla Canadensis .... Lake George, Niagara Falls, and Baltimore.
„ argentea ..... Fort William Henry, Lake George.
Rosa rubiginosa..... Kingston, Lake Ontario.
Amelanchier Canadensis.. Niagara Falls, Canada.
„ Botryopium.. St. Helen's Island, Montreal.
Cratægus arborescens .... Central Park, Chicago.

NATURAL ORDER, 45.—SAXIFRAGACEÆ.

Mitella diphylla ..... Toronto, Canada.
Saxifraga Virginiensis.... Au Sable Chasm.
Deutzia gracilis..... Park, New York.
Ribes floridum ..... St. Helen's Island, Montreal.
„ gracile ..... Niagara Falls, Canada.
„ aureum..... Rocks, Niagara Falls.
„ Cynosbate..... Kingston, Ontario.

NATURAL ORDER, 46.—CRASSULACEÆ.

Penthorum sedoides..... Island, Niagara Falls.

NATURAL ORDER, 63.—UMBELLIFERÆ.

Hydrocotyle sibthorpioides Fort William Henry, Lake George.
Thaspium aureum..... Au Sable Chasm.
Pimpinella integrifolia.... Catskill, Hudson River.
Chærophyllum procumbens Washington.
Daucus Carota ..... Fort McHenry, Baltimore.

NATURAL ORDER, 66.—CAPRIFOLIACEÆ.

Lonicera ciliata (Xylosteum ciliatum)..... Niagara Falls.
Sambucus Canadensis ... Kingston, Lake Ontario.

NATURAL ORDER, 67.—RUBIACEÆ.

Houstonia serpyllifolia ... Fort William Henry, Lake George.

NATURAL ORDER, 70.—COMPOSITÆ.

Aster spectabilis ..... Catskill, Hudson River.
Diplopappus linariifolius.. Niagara Falls, Canada.
Gnaphalium uliginosum.. Niagara Falls, and Catskill, Hudson River.
Cacalia diversifolia (?).... Island, Niagara Falls.
Lappa officinalis..... Chicago, Lake Michigan.

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NATURAL ORDER, 72.—CAMPANULACEÆ.

Campanula aparinoides .. Taunton, Mass.

NATURAL ORDER, 73.—ERICACEÆ.

Vaccinium corymbosum.. Au Sable Chasm.
,, Pennsylvanicum Fort William Henry, Lake George.

NATURAL ORDER, 81.—PRIMULACEÆ.

Trientalis Americana .... Au Sable Chasm.
Lysimachia thyrsiflora .. Fort William Henry, Lake George.

NATURAL ORDER, 82.—PLANTAGINACEÆ.

Plantago cordata ..... Catskill Creek, River Hudson.

NATURAL ORDER, 88.—SCROPHULARIACEÆ.

Verbascum Thapsus..... Niagara Falls and New York.
Verbascum Blattaria .... Washington Heights, New York.
Pentstemon pubescens.... Catskill Creek, Hudson River.
Veronica arvensis..... Botanic Gardens, Washington.
,, officinalis ..... Woodland Park, Saratoga.
,, serpyllifolia .... St. Helen's Island, Montreal.

NATURAL ORDER, 91.—LABIATÆ.

Lamium amplexicaule.... Botanic Gardens, Washington.

NATURAL ORDER, 92.—BORRAGINACEÆ.

Echium vulgare..... Catskill, Hudson River.
Cynoglossum officinalis .. Fort William Henry, Lake George.
Lithospermum linearifolium ..... Niagara Falls, Canada.

NATURAL ORDER, 100.—ASCLEPIADACEÆ.

Asclepias quadrifolia . ... Catskill, Hudson River.

NATURAL ORDER, 104.—POLYGONACEÆ.

Rumex Acetosella ..... Fort McHenry, Baltimore.

NATURAL ORDER, 113.—EUPHORBIACEÆ.

Euphorbia Helioscopia .. Niagara Falls, Canada.

NATURAL ORDER 122.—CUPULIFERÆ.

Quercus nigra (?) ..... La Fayette Park, Washington.
Fagus ferruginea ..... La Fayette Park, Washington.
Corylus Americana ..... Niagara Falls, Canada.

NATURAL ORDER 124.—MYRICACEÆ.

Comptonia asplenifolia .. Au Sable Chasm and Fort William Henry.

NATURAL ORDER 127.—CONIFERÆ.

Juniperus communis .... Kingston, Lake Ontario.
Thuya occidentalis ..... Niagara Falls, Canada.

ENDOGENS.

NATURAL ORDER, 142.—IRIDACEÆ.

Iris versicolor ..... Fort William Henry, Lake George.
Sisyrinchium Bermudiana St. Helen's Island, Montreal, and Fort William Henry, Lake George.

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NATURAL ORDER, 146.—TRILLIACEÆ.

Trillium grandiflorum .. Goat Island, Niagara Falls.
,, erectum ..... The Rapids, Niagara Falls.

NATURAL ORDER, 147.—LILIACEÆ.

Allium sativum ..... Baltimore and New York.
Smilacina stellata ..... Goat Island, Niagara Falls.
,, ciliata ..... Kingston, Lake Ontario.
,, trifoliata ..... Fort William Henry, Lake George.
,, bifolia ..... Fort William Henry, Lake George.
Myrsiphyllum asparagoides Conservatory, Washington.

NATURAL ORDER, 154.—CYPERACEÆ.

Scirpus palustris ..... Niagara Falls, Canada.
Eriophorum capitatum .. Fort William Henry, Lake George.
Carex flava..... Fort William Henry, Lake George.

NATURAL ORDER 155.—GRAMINEÆ.

Zea Mays ..... New York, Indian corn cobs.

NATURAL ORDER, 157.—LYCOPODIACEÆ.

Lycopodium dendroideum Quebec, Canada.

NATURAL ORDER, 158.—EQUISETACÆ.

Equisetum limosum .... Niagara Falls, Canada.

NATURAL ORDER, 159.—FILICES.

Lastrea montana ..... St. Helen's Island, Montreal.
,, Thelypteris..... St. Helen's Island, Montreal.
Aspidium acrostichoides.. Au Sable Chasm, Lake George.
Polypodium vulgare ..... Cedar Island, Niagara Falls.
Asplenium Fabianum .... Greenhouse, Alleghany City.
Osmunda interrupta..... Au Sable Chasm, Lake George.
Onoclea sensibilis..... Fort William Henry, Lake George.
Adiantum pedatum ..... Au Sable Chasm, Lake George.

MOSSES.

Bryum nutans..... Fort William Henry, Lake George.
,, cæspiticium ..... Baltimore and Lake George.
,, ... Baltimore and Lake George.
Funaria hygrometrica.... Niagara Falls and Lake George.
Climacium Americanum.. Niagara Falls.
Mnium affine (?) ..... Niagara Falls.
,, undulatum ..... Niagara Falls.
Amblystegium irriguum .. Niagara Falls.
Polytrichum commune... Fort William Henry, Lake George.
Hypnum rutabulum..... Fort William Henry, Lake George.

HEPATICÆ.

Marchantia polymorpha.. Fort William Henry, Lake George.

LICHENS.

Cladonia furcata (?) ....

FUNGI.

Æcidium grossulariæ ....
Schizophyllum commune On gatepost, Washington.

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ANTHROPOLOGY, ITS MEANING AND AIM.

BY JOSEPH SMITH, JUN., M.A.I.

(Continued from page 291.)

Up to the time of Buffon, although naturalists had studied the various creatures of the animal and vegetable worlds, it had not occurred to those entering into scientific investigation to study man from the same point. He had been regarded and studied as an individual; and Anthropology may be looked upon as having originated with the great thought of Buffon, that man must be studied as a species. Buffon was the first to investigate and regard man as a species, and he devoted his attention to the examination of his colour, physique, and external traits and characteristics. He was succeeded by Camper, a Dutchman, who began the study of skulls, showing that if we would understand the position of man this *comparison* must be of great importance in any laws of Anthropology. He compared the Negro skull with that of the European and the Ourang-outang, pointing out the facial angle, and drawing certain conclusions from it; but Blumenbach, a doctor of the German school, who may be regarded as the legitimate father of the science, pointed out the unsatisfactory results of these facial angular measurements, resulting from the union of two lines, one of which touches the forehead, and the other, drawn from the orifice of the ear, meets the former line at the orifice of the front teeth; and argued that the study of skulls, to be of any scientific value, must not be made individually but in lots, and subject to recognised rules. It was he who made the fundamental division of the human race into five sections, viz. :—

The European, or white race;
The Asiatic, or yellow race;
The African, or black race;
The American, coloured; and
The Malay,

on which, up to recent times, anthropological investigations have been principally based. This division, however, is far from perfect, and forms at the present time one of the most obscure problems of scientific anthropology. The great ideal of Blumenbach was the Unity of mankind, which, in his days, was not a generally accepted fact, and it was in opposition to the assertions, grave descriptions, mythological ideas, and theories regarding this human unity, which had

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been put forward even as late as the time of Voltaire,* that he worked; the happy results of his labours eventually being the establishment of this ideal. Anthropology like other sciences had to be followed on fixed laws, or rules, and one of the principal of these is to draw a distinction everywhere between what belongs to the brute and what belongs to the man; then regard the position of man to animals. The capacity of brain power must be noted as being of the utmost consequence, and in his calculations Camper based his conclusions on the assimilation of the facial angle in the skull of the Negro to the angle derived from the cranium of the ourang-outang, and calculated his conclusions rather on this angle than on the cranial capacity. But although the skull of the Negro may show a lesser angle than that of the European, yet the capacity of the brain is, with a slight variation, the same. A further principle to be observed when investigating matters relating to man and his position in creation, is to admit no fact which is not supported by trustworthy documents, since, by strict adherence to this, everything which is puerile or tending to exaggeration and legend will be eliminated and excluded from science, while one of the most important factors in this branch of knowledge is to observe that all comparisons from extreme to extreme be only made by means of all the intermediate terms and shades possible. Comparison within recent years has been only by extremes, but anthropologists have endorsed the theory of Blumenbach that it is only the extremes which seem to separate the human species into specific and decided races; the gradual shades and continuous intermediate terms marked in man making him form but one mankind.

Man must again be studied under three divisions, for on such is the true study of man founded—*Philology and History*, *Relation of Races to Climates*, and *Migrations and Intermixtures*. In the investigation of man under this last head Philology comes into practical use, assisting and showing how to trace to their origin the various migrations and different minglings of race with race.

The science lost its progenitor in 1840. Amongst the many rules this great anthropologist laid down was the great and general classification based on the characters presented by the configuration of the head, so different in the different races as to the proportion of the skull to the face, and the proportion of the encephalon to the organs of sense and jaws.

* The great naturalist Linnæus even erred so far as to describe man and arrange him in the same genus as the ourang-outang, the *Homo nocturnus*, *H. Troglodytes*, and *H. sylvestris* of that naturalist being no other than the ourang.

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The quintal arrangement of Blumenbach is called in question as either having too wide a scope or not being sufficiently indicative of its meaning, and Waitz seems to think that this arrangement was founded on the corresponding geographical scheme of five parts of the globe.

According to this division the Ethiopian, or black, and Mongolian were made to indicate the two extremes, the White race taking its place as the centre of the division, the American intervening between the White and Mongolian races, and the Malay between the Ethiopian and the White race or Caucasian; thus—

Mongolian;
American;
White race, or Caucasian;
Malay;
Ethiopian, or black;

by which, assuming the unity of the human race, the Caucasian is made the centre of the system, and consequently must be regarded as the normal type of the human race. This system has, however, been proved untenable so far as the position of the various divisions one to the other is regarded, for in taking into consideration not only the shape of the skull but other anatomical differences and developments, Waitz maintains that the White race and Negro, form the two extremes in any scale of division, the latter on account of his resemblance to the ape, the former because in him this apish resemblance almost entirely disappears.

Notwithstanding the diversity of opinion which may have greeted the enunciation of such an hypothesis, there is so much in the crude theory of Blumenbach that it formed the basis of further investigation, which resulted in the tabular arrangement I have previously given. Anthropologists even at the present time are, from their investigations, inclined to opinions which do not run in direct harmony with the tables laid down either by Blumenbach or Waitz. Lacepede and Dumene were inclined to increase this quintal table by the addition of a sixth division or variety, embracing the Hyperborean race of the polar regions; while Virez ("Nat. Hist. du Genre Hum.," i., p. 318, 1884), points out as the sixth variety the Hottentots and Papuans. Cuvier, the naturalist, based his arguments on three varieties, viz., the Mongol, Negro, and Caucasian, which may indeed be accepted as the three pivots of the derivation of nations and races; and while Pritchard, Smith, and Latham are inclined to adopt the division into five sections, Pickering assumes eleven, Bary fifteen, Desmoulins sixteen, and Agassiz and Nott assume an

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indefinite number of species. So too, in speaking of the inhabitants of Australia, who are regarded as belonging to and springing from one family by all anthropologists, Hombron ("Zoology," i., p. 312, in Urville, Voy. au Pole Sud) speaks of them as being members of different varieties, and considers the inhabitants of Van Dieman's Land as belonging to a distinct species.

Waitz ("Anthropology," vol. i., p. 234), commenting on the division established by Cuvier, says:—"If the Malay and the American be added to the three chief forms adopted by Cuvier, we can scarcely avoid adding the Australians, Austral Negroes (Negrillos), the Papuans, and the Hottentots. Nor will this be sufficient; all the intermediate tribes between the Negroes and the White, namely the Kaffirs, Nubians, Gallas, Abyssinians, and Berbers, have an equal claim to consideration. This applies also to the Battas, the cranial form of whom is intermediate between that of the Europeans and Malays." With the Mongolian type there is further associated the so-called Hyperborean type, though the assumption of a separate polar race presents many difficulties, and, as already shown by Vater in his "Mithridates" (vol. iii., p. 317), indicates a considerable deviation.

But least of all can the aboriginal Americans be comprehended in the division, for whatever Morton and his school may assert as to the similarity of the cranial type in all the varieties of South and North America, it is shown by their own researches that differences of shape are as considerable there as in those parts in which they are considered fundamentally different. Some are long-headed and some are short-headed, others again are round-headed; the present Peruvians having small square skulls, with a compressed occiput ("Morton Cran. Am.," pp. 65-115); and Tschudi has pointed out three essential distinct cranial forms of the original inhabitants of Peru."

Retzius, however, was the first who reduced the study of the cranium to a fixed basis, which may be regarded as correct so far as it decides the shape and form of the skull. The basis of his theory was on the principle that "psychical individuality of a people must be founded on, and expressed by, the development of the brain, as indicated by the skull," and he established from his cranial observations two distinguishing classes, the dolichocephalous, from the Greek δολιχος, "long," κεφαλη, "head," which term is applied to distinguish a cranium elongated from front to rear, or, to express this idea numerically, a cranium the longitudinal diameter of which is to its transverse diameter as 100 is to 68; and the

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brachycephalous, derived from βραχυς, "short," κεφαλη, "head," applied to those skulls where the relation of the longitudinal to the transverse diameter is such as 100 is to 80. This principle, although much in use amongst anthropologists, has not that great merit of decision in disposing the crania in their relative position regarding nationality, which its author had anticipated; for both classes of these skulls may be found, and are, I may say, invariably found, amongst the same people; nor must it be supposed that the projection backwards of the cranium is a sign of inferiority, for even amongst our own race are found both long heads, or dolichocephalic, and short heads, the brachycephalic. The further observations of Retzius began to convince him that the law he had laid down was less infallible than he had at first considered it, and clearly showed that such characteristics would not be regarded as a criterion of intellectual excellence; but he further added two other distinguishing classes, or secondary classification, based on a point in the anatomical structure of the face, which is of more importance in anthropological calculation, Figuier asserts ("Human Race," p. 25), than any calculation made from the elongation of the cranium. This is the projectiveness of the human face, and has its description in the term *prognathism* from προ, "forward," and γναθος, "jaw," applying itself to describe the jutting forward of the teeth and jaws, and *orthognathism*, likewise derived from the Greek ὀρθος, "straight, and γναθος, "jaw," descriptive of the facial uprightness of the jaw. We now have the human crania in the following sections:—

1.—Gentes dolichocephalæ orthognathæ—or nations with long-shaped heads and uprightness in the jaw; or perhaps better, flat-faced.

2.—Gentes brachycephalæ orthognathæ—nations with short heads and flat faces.

3.—Gentes dolichocephalæ prognathæ—nations with long-shaped heads and protruding jaws.

4.—Gentes brachycephalæ prognathæ—short-headed nations, with projecting jaws.

Such were the divisions of Retzius, of which all four examples are met with in Asia in equal proportions; while the first and second, or examples of short-headed flat-faced and long-headed flat-faced crania, are found in Europe. The third and fourth division—the short-headed projecting-jawed and the long-headed projecting-jawed faces—predominate in the South Seas, not infrequently examples of the brachycephalæ orthognathæ being found,

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which may be explained by intermixture. Africa has a predominant type in the dolichocephalæ prognathæ, long headed and projecting jaws; and America gives us alternately forms belonging to the third and fourth divisions, dolichocephalæ prognathæ and brachycephalæ prognathæ, not excluding examples of the second, brachycephalic orthognathic type. Thus we have in Europe ("Muller's Archiv.," p. 271, 1848) examples of the brachycephalæ orthognathæ—short headed, upright jaws or flat faces, in the Turks, Lapps, Slavs, Basques; Asia giving examples of these crania in the Samoiedes, Burates, Afghans, and Persians. In the East Indies and South Seas the Tahitians, Malays, and Papuans belong to the brachycephalic prognathæ, or short-headed long-jawed examples; the Negroes, Hottentots, and Kopts being examples of the long-headed projecting-jawed races — dolichocephalic prognathæ. It will be noted from the foregoing remarks how great the variety and mingling of types is, and the questionable result of any attempt at classification on cranial mensuration only, when they transgress the distinguishing bond of the three chief types as illustrated by the Negro, the Mongol, and the European (Zeune in "Ueber Schädelbildung," 1846); yet the investigations of those who have done so much for Anthropology, although they may not quite harmonise with more recent discoveries, must not be depreciated, since they have aimed at elevating the study of man, and arriving at some recognised classification of the various types from the development of a cranial race theory. Nevertheless it is highly probable that there does exist a distinguishing type of national cranial form in every people, which, if only this could be established, would prove one of the greatest discoveries in the interests of Ethnography; but our knowledge of the variation of shape in individual national types is yet too small to enable us, with that precision so necessary to any science, to determine what ranges itself within, and what classes itself without, any particular type. The observations and studies of Hueck "De Craniis Esthonum," Zeune, Tschudi ("Muller's Archiv.," p. 277, 1845), and Meyer (Ibid, p. 510, 1850), all illustrate the difficulty of assuming the cranial form as an absolute mark of race, but I am inclined to believe that this apparent mingling of types can and will be eventually explained away by a careful investigation, and an attentive application of the rule set forth by Blumenbach, that any investigation must not be based on extremes, but that such studies must be made only by all the intermediate terms and shades possible, from

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extreme to extreme, since thereby the most minute variation will be detected, and an average figure or scale struck for the establishing of the normal type of a race cranium.

According to the measurements of Parchappe, "Recherches sur l'encéphale," races are placed in the following order according to the volume of the head:—Caucasians, Negroes, Mongols, Americans, and Malays. Lawrance differs from Parchappe in the estimation of brain capacity, and places the Malay between the Europeans and Mongols, while Tiedemann, "Der Hirn des Negers," 1837, gives the following as the mean capacity:—

	Cases.		Ounces.
European	135	.....	$40\frac{2}{3}$
American	31	.....	$40\frac{1}{3}$
Mongol	43	.....	$39\frac{2}{5}$
Malay	77	.....	$38\frac{1}{5}$
Adult Negro	48	.....	$37\frac{11}{12}$
Asiatics and Negroes of the white race	39	.....	$37\frac{2}{5}$

Various other writers, who have made independent measurements as to the mean average of the brain power, arrive at different standards, each out of unison with the other, so that no certainty can be drawn from such calculations in favour of the doctrine that capacity of cranium indicates the amount of mental endowment. In the commencement of this paper it was stated, on the authority of Camper, that the brain of the African (Negro) was equal to that of the European, which statement will require some modification if we look to the table of Tiedemann; but I argue that the brain of the African, if developed in the same ratio to that of the higher developed European, will be found to be equal, and moreover if the negro brain be set in comparison against that of a European subject of the same standard of intellectual endowment as the African, the computation of Camper will be found favourable. The variation which is found in skulls belonging to the same country and same age may be attributed to climatical influence, the method and habit of living, &c. Crantz inclines to the idea that the inhabitants of the northern parts have the body sinewy and square, those peoples dwelling in the south being of a more soft and elegant habit. This theory is endorsed by Leem, who treats on the Lapps and Finns; by Hogshorn, on the Lules; by Pallas, on the Calmucks; by Crantz, on the Greenlanders; and by Parkinson, on the New Zealanders and New Hollanders.

(To be continued.)

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A WEEK'S WORK AMONG THE CANNOCK CHASE LEPIDOPTERA.

BY THOMAS GIBBS, JUNR.

The following notes on a week's stay at Colwich, working the Lepidoptera of Cannock Chase, may be interesting to your entomological readers.

My brother and myself arrived at Colwich on Monday afternoon, the 29th June, and left the following Saturday, so that we really had only five days' collecting; in that time, however, we were favoured with fine weather, and by hard work managed to come across several species that were new to us, and also to fill up some of the blanks in our collection.

The Butterflies were very poorly represented, the only species occurring in any abundance being *Cœnonympha pamphilus*, which swarmed all over the Chase.

Among the Bombyces we were more fortunate, taking amongst others *Hepialus velleda*, abundant among the bracken fern; *Lithosia mesomella*, a few specimens in marshy spots by streams on the Chase; *Nemeophila russula* and *plantaginis*, a few specimens of these two species flying over the moor in the sunshine; *Platypteryx falcataria* and *lacertinaria*, one specimen of each flying among birches by the ponds in Oakedge Park. We also found three larvæ of *Bombyx quercus* among the heather, and a batch of ova of *B. rubi* on the Wolseley park fence.

Among the Noctuæ we were very unsuccessful, owing probably to the cold nights. We sugared on two occasions, the only visitors being *Acronycta rumicis*, *Rusina tenebrosa*, *Agrotis strigula (porphyrea)*, *Triphæna pronuba*, *Noctua plecta*, *Euplexia lucipara*, *Hadena thalassina*, and *H. oleracea*. *R. tenebrosa* and *A. strigula* were the only species that came at all freely. One day we saw *Anarta myrtilli* flying over the moor in some abundance; we managed to secure a few, but as all entomologists are aware they are much more easily seen than caught.

The Geometræ were more plentiful than any of the other groups, our captures numbering twenty-three species, of which the following were the best:—*Asthena luteata*, of this pretty little wave we took five specimens, among alders between the Oakedge ponds; in the same spot we found *Eupisteria obliterata* (*heparata*), *Melanippe sociata* (*subtristata*), *Coremia designata* (*propugnata*), and *Larentia viridaria* (*pectinitaria*), all rather common. *Ematurga atomaria* swarmed all over the

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moor, and there we also found *Aspilates strigillaria* and *Eubolia plumbaria*, both common; one *Panagra petraria* and two *Scodiona belgiaria*; *Bupalus piniaria* abounded among the Scotch firs; and we found the following species settled on palings—*Melanthia ocellata*, two specimens, and four species of *Eupithecia*, viz., *E. nanata*, abundant; *E. castigata* and *lariciata*, both fairly common; and two *E. pulchellata*.

Most of our time was spent on the Chase and in Oakedge Park, but one day we walked to Chartley, and took *Lycæna icarus* (*alexis*) and *Aspilates strigillaria* on the railway bank near Stowe station, and two specimens of *Acidalia fumata* and one of *Euclidea mi* on the famous Chartley Moss.

The above list of captures is not very extensive, but may serve to show how much can be done in a short time in one of the best localities in the Midland Counties; it includes several species that have not to my knowledge been previously recorded from the localities mentioned, notably *Lithosia mesomella*, *Scodiona belgiaria*, *Platypteryx lacertinaria* and *Nemeophila plantaginis* from Cannock Chase, and *Aspilates strigillaria* and *Acidalia fumata* from Chartley.

METEOROLOGICAL NOTES.—September, 1885.

The barometer was rather high at the commencement of the month, but fell decidedly till the 5th, when it rose, through a series of fluctuations, to the 22nd, its highest point (30·302 inches). Thence it fell till the end of the month, reaching 29·368 inches at 6 p.m. on the 30th. Temperature was rather above the average till the 22nd, when a "cold spell" set in, which reduced the mean to 54·7°, or nearly 2 degrees below the average. The highest readings were on the 15th, when 75·3° was registered at Loughborough, 73·5° at Henley-in-Arden, 73·0° at Hodsock and Coston Rectory, and 72·4° at Strelley. In the rays of the sun, 127·6° at Strelley on the 6th, 126·4° at Loughborough on the 3rd, 124·3° at Hodsock on the 5th. The minima were lower than for some years past, the thermometer recording 28·0° at Coston Rectory and 28·7° at Hodsock on the 26th, 30·0° at Henley-in-Arden and 30·4° at Loughborough on the 28th, and 30·2° at Strelley on the 26th; on the grass, 22·9° at Hodsock and 24·7° at Strelley on the 26th, and 28·7° at Loughborough on the 28th. Rainfall was excessive in the South Midlands, the total values being 3·44 inches at Loughborough, 3·37 inches at Henley-in-Arden, 3·11 inches at Strelley, and 2·89 inches at Coston Rectory; at Hodsock, in North Notts, the total was only 1·77 inches. Heavy falls occurred on the 10th; 0·95 inches at Henley-in-Arden, 0·94 inches at Loughborough, and 0·71 inches at Coston Rectory. The number of "rainy days" varied from 19 to 21. A slight fall of snow occurred at Coston Rectory on the 25th. Sunshine was decidedly above the average. Lightning and thunder were observed at Loughborough on the 3rd and 6th, a solar halo on the 16th, and a lunar halo on the 24th.

Wm. Berridge, F. R. Met. Soc.

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Natural History Notes.

THE BRITISH MOSS FLORA, Part IX.—We are pleased to see this part of Dr. Braithwaite's great work. It will be greatly valued by British bryologists. It contains four plates, with illustrations of twenty-five species. In the text, descriptions are given of fourteen species of *Tortula*, *Pleurochæte squarrosa*, and fifteen species of the comprehensive genus Mollia.

MR. CLEMENT L. WRAGGE has been commissioned by the Queensland Government to visit and report "as to the best means of establishing Meteorological Stations in Queensland, including Cape York Peninsula and Torres Straits." Mr. Wragge, who lately returned from a scientific expedition on his own account to North Queensland, commenced this important work early last month, and expected to reach Normanton, in the Gulf of Carpentaria, about the 15th October.

NEW BRITISH FUNGI.—Some time ago I mentioned the discovery of the first species of Mortierella recorded as growing in Britain; it was allied to *M. tuberosa*, but I was unable to complete the identification owing to the paucity of the material. I afterwards found a second species, *M. Candelabrum*, in larger quantity, and have just now been gratified to find another species of this beautiful and curious genus, *M. polycephala*, Coemans. This has occurred in great quantity on damp Sphagnum and other mosses. I have also lately met with *Helminthosporium hormiscioides*, and *Fusidium lycotropum*.—W. B. GROVE, B.A.

EJECTED PELLET OF A ROBIN.—On the 4th of October a cock robin alighted upon the grass about three feet from my breakfast room window. He stood there quite still for a minute or two, facing me as I looked out. I noticed a convulsive movement in his throat, and presently he opened his beak wide, as if gaping, shook his head smartly, and there fell out of his mouth a worm about 1½in. long, and a black substance rather smaller than a horse-bean. The robin picked up the worm again in his bill and flew away with it. I went out to examine the black object which he had left behind, and found it to be a pellet of hard fragments half-an-inch long and a quarter of an inch thick. On macerating this pellet in water it was found to consist of fragments of beetles and flies, the legs, broken elytra, wings, jaws, heads, &c.; also the skin of a caterpillar three-quarters of an inch long, and small green particles of vegetable matter, some of which were inside the skin of the caterpillar and may have formed the food of that creature, and not of the robin. There were, however, fragments of grass a quarter of an inch long, not inside the caterpillar, but these may have been taken up accidentally with worms.

F. T. MOTT.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—GENERAL MEETING, September 29th. Mr. T. Bolton exhibited some galls on the petals of the leaves of the poplar from Selly Oak, and *Stemonitis fusca*, one of the Myxomycetes; and, on behalf of Mr. Cecil Davies, some pupa cases from South America. Mr. W. B. Grove, B.A., exhibited the following fungi:—*Pestalozzia*

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longiseta on Azalea leaves (new to Great Britain), found at Sutton Coldfield; also *Agaricus jubatus* and *Phragmidium violaceum* from Barnt Green. Mr. A. Browett made some interesting remarks about the late meeting of the British Association at Aberdeen.—GENERAL MEETING, October 6th. The President made a few remarks upon the work done by the Society during the past session, and he expressed a hope that more of the members would attend the meetings in the future, and suggested that the meetings might be made more attractive and enjoyable to the ordinary student if the subjects were treated in a more popular and less technical manner, at the same time not to interfere with the specialist; that an account be kept of the various excursions, work done, specimens obtained and verified, and any other information, such account to be entered in a book to be called the log-book of the Society's excursions, and that the record of each excursion should be read at the next meeting following. He thought this course, if adopted, would add materially to the interest of the meetings and prove a valuable source of reference. Mr. T. Bolton exhibited oak spangles (galls) made by the insect *Cynips longipennis;* Mr. Saunders, an entomostracon; Mr. J. Levick, *Zoothamnium arbuscula* and *Cordylophora lacustris;* Mr. J. Morley, the male Gall Fly (*Trypeta cardui*) and the Horned Ichneumon Fly (*Eulophus nemata*), both mounted without pressure. Mr. J. T. Blakemore, live foraminifera from Aberystwith; Mr. J. Edmonds, the bush spider; Mr. W. P. Marshall, a flower of lobelia; Mr. C. Pumphrey, beaded hairs in the flower of the pansy; Mr. Cecil T. Davies, skulls of British birds; Mr. A. Browett, *Lycopodium clavatum*, from Scotland; Professor C. Lapworth, a number of geological charts and maps of the Birmingham district, prepared by the students attending his lectures at the Mason College. Mr. J. Rabone exhibited some objects, kindly lent by Mr. W. Spencer, Regent's Place; the first in point of interest was a part of a carbonised branch of a coniferous tree, found at a depth of 195 feet below the surface in the Kimberley diamond mine in South Africa. The branch had been converted into a brittle lignite, and adhering to it was a portion of the rock in which it had been embedded, and upon the surface was to be seen a small diamond *in situ*, about as large as a grain of wheat. He also showed a number of shells of the Avicula or pearl oyster, and portions of others which had been cut by the button lathe. The origin of the pearl is due to the presence of some foreign substance within the shell, which the oyster, not having the means of extruding, covers over with nacre, of which the pearl is composed; specimens were shown which (the pearls being split) exhibited the bodies of small crabs perfectly preserved; a portion of the case of *Terebella* was seen to have been enclosed, and other pearls had been formed over small stones. A number of small pearls, of a dullish yellow appearance, taken from the common oyster, and others of a darker hue from the common mussel, were also shown. Mr. R. W. Chase exhibited the following birds:—*Muscicapa atricapilla*, Pied Flycatcher, male, female, and young, Ebchester; *Locustella nævia*, Grasshopper Warbler, young, in two stages, near Newcastle; *Serinus hortulanus*, Serin Finch, adult, Yarmouth, 14th June, 1885; *Lanius pomeranus*, Woodchat Shrike, adult male, Yarmouth, 16th May, 1885; *Œgialitis cantiana*, Kentish Plover, female, Breydon Flats, 8th May, 1885; *Phalaropus hyperboreus*, Red-necked Phalarope, male, and young in down, Shetland, 11th July, 1882; *Strepsilas interpres*, Turnstone, male, Breydon Flats, 14th May, 1884; *Numenius phœopus*, Whimbrel, in the down, Hascosea, 3rd July, 1882; *Stercorarius catarrhactes*, Common Skua, Shetland, 10th July, 1882; *Stercorarius crepidatus*,

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Richardson's Skua, adult female, showing light and dark forms. —BIOLOGICAL SECTION, October 13th. Mr. W. P. Marshall in the chair. Mr. J. E. Bagnall, A.L.S., read a paper on the "Flora of the Anker Basin," in which he gave an account of the course and drainage of the Anker, the physical features of the country, the number of plants he had found, their classes of citizenship, geographical distribution, and also compared the flora of the Anker with that of the Blythe. The paper was illustrated by microscopical preparations and numerous specimens, among which were *Didymodon flexifolius*, *D. luridus*, *Sparganium neglectum*, new to North Warwick, and other rare specimens. He also handed in full lists of the flowering plants and mosses of the Anker district. Mr. T. Bolton, F.R.M.S., exhibited for Mr. Blakemore winged aphides, species not determined. Mr. W. Spinks, of the Royal Nurseries, Edgbaston, exhibited a living specimen of a large green grasshopper, which is supposed to be a South American species, introduced with some bulbous plant. Mr. Bagnall, for Mr. Henry Groves, *Liparis loeselii*, a very rare plant from Norfolk. Mr. W. B. Grove, B.A., gave an account of his visit to the Woolhope Fungus Foray, and exhibited a number of fungi from Hereford and the Sutton district, among others *Lactarius vellereus*, *L. torminosus*, *L. mitissimus*, *Ag. Badhami*, *Ag. rhacodes*, *Ag. fusipes*, *Ag. nudus*, *Ag. grammopodius*, *Ag. pisciodorus*, *Ag. hæmorrhoidarius*, *Geaster Bryantii*, *Bovista nigrescens*, *B. plumbea*, *Lycoperdon gemmatum*, *Cortinarius ochroleucus*, *C. mucifluus*, *Cantharellus tubæformis*, *Hirneola auricula-judæ*, *Boletus laricinus*, *Polyporus annosus*, all from Hereford; *Ag. pseudo-purus*, *Ag. butyraceus*, *Ag. dryophilus*, *Ag. rubescens* (without scales), *Ag. galopus* var. *candidus*, *Ag. leucogalus*, *Ag. metachrous*, *Ag. carcharias*, *Cortinarius tabularis*, *C. saturninus*, *Marasmius peronatus*, *Lactarius glyciosmus*, *Ag. asterosporus*, *Russula emetica*, *R. ochroleuca*, *R. citrina*, all from Little Sutton and Bradnock Hayes; *Ag. cirrhatus* (with *Stilbum vulgare*, on decayed *Lactarius deliciosus*), *Boletus flavus*, *Ag. terreus*, *Ag. inamœnus*, from Sutton Park; *Niptera Riccia*, new to Britain, *Dendrodochium citrinum* (sp. nov.), and *Actinonema Rosæ* (in good fruit), all from Sutton; and *Diplodia hederæ*, new to Britain, from King's Norton. Mr. W. H. France, the cardoon, *Cynara cardunculus* (?), a beautiful thistle, first noticed as a cultivated plant by Parkinson, 1629; it is esculent, and has the power of coagulating milk.—MICROSCOPICAL GENERAL MEETING, October 20th. Dr. A. M. Marshall presented to the Society a copy of a new edition of his work upon the frog. Mr. W. B. Grove, B.A., exhibited *Helicosporium lumbricoides*, Sacc. (new to Great Britain), *Tetraploa aristata*, B. and Br. (very rare), *Helotium scutula* var. *Lysimachiæ*, Phill., all from near Sutton; *Coniothyrium concentricum*, *Coremium vulgare*, and *Tripospermum elegans*, from Hereford; also, to illustrate Mr. Grattann's paper, the following sea-weeds:—*Cladophora rectangularis* and *Polysiphonia elongata* (in fruit). Mr. W. H. Grattann's paper was then read upon "The irregularity of appearance of some species of marine algæ." After the paper a discussion took place, in which several of the members joined.—SOCIOLOGICAL SECTION. At the ordinary meeting, held on Thursday, 15th October, the President (Mr. W. R. Hughes, F.L.S.), delivered a brief address, in which he alluded to the satisfactory progress of the Section and to several interesting matters connected therewith. Mr. W. B. Grove, B.A., ably expounded Chapters I., II., and III. of Part IV. of Mr. Herbert Spencer's "Principles of Biology," Vol. 2, on "The Problems of Morphology and on the Morphological Composition of Plants." The President was unanimously requested to write a letter to Mr. Herbert Spencer, congratulating him on the appearance of a third edition of Vol. I. of "The Principles of

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Sociology," and on the completion of Part VI. of that work on "Ecclesiastical Institutions." On Saturday, the 17th October, the members of the Section and other friends, to the number of nearly fifty, paid a second visit to George Eliot's country, and were, by the kindness of C. N. Newdegate, Esq., M.P. (who personally conducted them over the building), allowed to see Arbury Hall, the Cheverel Manor of Mr. Gilfil's love story; after which they drove to South Farm (the Hall Farm of Adam Bede), and from thence to Coventry, where a substantial tea was served at the King's Head Hotel. After tea, some opening remarks were made by the President (Mr. W. R. Hughes) with reference to the early association of Mr. Herbert Spencer with George Eliot, and the mutual influence for good each had had on the other; after which Mr. W. Showell Rogers, M.A., LL.M., delivered a most interesting address on George Eliot's works. Thanks were voted to Mr. Showell Rogers for his address, and also to Mr. C. N. Newdegate, M.P.; and to Mr. Alfred Browett, hon. sec. of the Section, for the able manner in which he had organised the excursion.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—September 19th. A visit was made, by invitation, to Warley, to inspect the geological collection of Mr. Holden. The specimens were very numerous, and comprised fossils, &c., from nearly all formations. A hearty vote of thanks to Mr. Holden for his kindness brought a pleasant afternoon to a close.—September 21st. Mr. H. Insley exhibited a polished slab of chain coral from the Rushall Canal; Mr. Hawkes, the following fungi:—*Xenodochus carbonarius* and *Sphærotheca castagnei*, both on Great Burnet; *Uromyces intrusa*, *Cystopus candidus*, *Phragmidium mucronatum*, *Puccinia lychnidearum* and *Uromyces ulmariæ*, the latter on *Rosa canina;* Mr. Moore, internal shells of *Limax flavus;* Mr. J. A. Grew, a male specimen of convolvulus hawk moth, *Sphinx convolvuli;* Mr. Evans, *Aviculopecten papyraceus* from the Gannister beds, Staffordshire, and native copper from Lake Superior. Under the microscopes, Mr. Tylar showed eggs of *Scatophaga stercoraria;* Mr. Hutchinson, *Paludicella Ehrenbergii;* Mr. J. W. Neville, head of Phalangium; Mr. Hawkes, conceptacles of hop mildew, *Sphærotheca castagnei*.—September 28th. A discussion on "The Ice Age" was opened by Mr. Rodgers reading a paper that explained the theory of Lieut.-Col. Drayson that the earth's axis moving in a circle round a centre six degrees removed from the pole of the ecliptic brings about a great change in the obliquity of the earth's axis, and thereby brings the poles more under solar influence in the summer, and, in the winter, by bringing down the arctic circle to a low latitude, the result is a hot summer and severe winter each year. This polar movement is completed every 31,000 years. To the ice accumulated during the winter and removed each summer for 16,000 years is attributed the glaciation of Europe and elsewhere. The discussion was adjourned.—October 5th. Mr. Madison exhibited specimens of *Helix pulchella* var. *costata* from Minworth; Mr. Hopkins, *Helix aspersa* var. *albofasciata;* Mr. C. F. Beale, a specimen of long-eared bat, *Plecotus auritus*, also a series of photographs of microscopical objects; Mr. Hawkes, the following fungi:—*Trichobasis oblongata*, *Puccinia bullaria*, *Sphærotheca pannosa*, and *Uncinula bicornis*, the latter under the microscope. The discussion on "The Ice Age" was continued by Mr. H. Insley explaining the well-known theory of Dr. Croll.—October 12th. Mr. Hopkins exhibited specimens of *Paludina contecta* and *Helix aspersa* var. *unicolor;* Mr. Madison, *Helix pomatia* and very young specimens

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of the same; Mr. Moore, *Helix relevata* and *Achatina acicula*. A paper was then read by Mr. Evans on "The Drift," which described superficial layers and the extent to which they were formed of older rocks. The Moseley drift was particularly dealt with, as being the chief field of the writer's labours. The paper enumerated the different rocks found there, and also the fossils contained in them, comprising specimens of *Rhynchonella*, *Lingula*, *Orthis*, *Pentamerus*, *Meristella*, *Spirifer*, *Aviculopecten*, crinoidal stems, worm tracks, fragments of Trilobites and Lepidostrobus. The fossils bearing a strong resemblance to those of the Bunter beds, the writer held that the drift was a redistribution of those pebbles, and that they were originally derived from an old land barrier running across central England, some outlines of which were pointed out. The writer, in conclusion, hoped to be able at a future time to give some results of work in the Bunter beds, by which he hoped further light would be thrown upon this question. The paper was rendered additionally interesting by an exhibition of the fossils referred to.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY.—SECTION D, ZOOLOGY AND BOTANY. Chairman, F. T. Mott, F.R.G.S.—Monthly meeting, Wednesday, October 21st. Attendance twelve (four ladies). It was announced that the following three members of the Society had joined this section, viz.: Dr. Tomkins, R. Overton, Esq., and A. G. Turner, Esq., B.A. Arrangements were made for a fungus foray to Swithland Wood, &c., on Wednesday, the 28th October, at which Dr. Cooke, of London, had promised to assist. A covered brake to start from the Bell at 10 a.m. The following objects were exhibited by various members, viz.: By Mr. Grundy, a set of microscopic slides of entomological subjects, prepared by himself without pressure, the cells being made of a ring of tin with several slight grooves filed across to allow the escape of air bubbles; by Miss Grundy, a box of very small and delicate shells, chiefly *Pecten*, from the sea shore; leaf and abortive panicle of *Rhus cotinus*, the wig tree; leaf of the camphor laurel, *Laurus camphora;* and a well-executed drawing of a longitudinal section of the fruit of *Rubus fruticosus* var. *laciniatus*, × 4; by Mr. F. Bates, a slide of the remarkable alga, *Bulbochæte mirabilis*, found on submerged leaves of *Ranunculus aquatilis*, near Narborough, and new to the county; also living clusters of desmids *(Cosmarium)* in water, with prepared slides for the microscope; by Mr. E. F. Cooper, a branch of *Rhamnus catharticus*, with abundance of ripe fruit; by Miss Noble, a fruiting branch of an almond tree; by Miss Iöns, leaves of the Canadian scarlet oak in their autumnal colour; by the Chairman, specimens of the grass called "onion twitch," *Arrhenatherum avenaceum* var. *bulbosum*, showing the knobs at the base of the stem; and a sunflower, *Helianthus annuus*, of unusual size, 11in. across the disk, 16in. across the ray, weighing 3lbs. The plant from which it was cut was 9ft. 3in. high, with a stem 1½in. diameter, and leaves 16in. broad. Mr. Thomas Carter, LL.B., read a paper on "Some Alpine Plants of Britain," illustrated by mounted specimens of about forty species out of the hundred which belong to the Arctic flora, and by a series of maps showing the distribution of these species over the globe and in the British Islands, and discussing the different theories which have been suggested to account for their isolated occurrence on the summits of various mountain ranges. Mr. F. Bates read a short description of the fresh-water alga, *Bulbochæte mirabilis*.

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THE PRINCIPLES OF BIOLOGY.

BY HERBERT SPENCER.

Exposition of Chapter XII.—On "Distribution."

BY WILLIAM MATHEWS, M.A., F.G.S.

In studying the distribution, on the earth's surface, of any group of organisms, two facts, of widely different significance, are presented to our attention. First, the character of the inhabitants of any given locality depends upon the nature of the locality; secondly, two localities approximately similar in nature will, if sufficiently far apart, be tenanted by different collections of organisms; the species inhabiting them will, as a general rule, be representative and not identical.

In the remarks which I am about to offer on the subject of distribution, I propose to examine briefly some of the leading phenomena presented by the distribution in space of flowering plants.

The habitats of such plants are characterised by one or more of the following variations and conditions:—

(A.)—Differences of land and water—
- Marine.
- Fresh water.
  - Stagnant.
  - Running.
- Marsh.
- Land.
  - Littoral.
  - Inland.

(B.)—Differences of soil—
- Calcareous.
- Argillaceous.
- Siliceous.

(C.)—Differences with respect to cultivation or otherwise—
- Meadows, Pratal.
- Pastures, Pascual.
- Arable land, Agrestal.
- Heaths, Ericetal.
- Road sides, Viatical.
- Hedges, Septal.
- Woods, Sylvestral.
- Rocks, Rupestral.

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(D.)—Differences of climate—
Latitude.
Extreme temperatures in summer and winter.
Altitude.
Humidity.
(E.)—Differences arising from the presence or absence of other plants.
(F.)—Differences arising from the presence or absence of certain animals and especially of insects.

Influences of the above nature are called by Herbert Spencer "Negative." What is meant is that the absence of one or more of the above conditions will determine the absence of any given plant, but the presence of those conditions will not necessarily determine the presence of such plant. We are thus led to the consideration of the second of the main facts of distribution, viz., that similarity of conditions is frequently accompanied by great dissimilarity of Fauna and Flora.

The explanation is that the Fauna and Flora of any area on the earth's surface is derived from that which immediately preceded it in time, and that similar variations of condition acting on dissimilar organic materials have produced dissimilar results. The earth's surface has been in a state of continuous modification throughout past ages, and corresponding modifications have occurred in its organic inhabitants. The present phenomena of distribution are the result, and their study enables us to read more readily the past history of the earth.

Before the distribution of plants can be used as a key to that history, we must understand the various means by which distribution is effected or we may fall into serious error.

1st.—A number of plants are distributed all over the world by the agency of man. They are generally of intense vitality, of very unprepossessing appearance, and not only of no economic value but great hindrances to cultivation. Such are the thistle, dock, and nettle, and other noxious weeds. The way in which these plants colonise a foreign country may be seen by a glance at the Flora of New Zealand. The Canterbury Province in the Southern Island contains 750 native phanerogamous plants. Within the last twenty years 250 European species (one third in number of the indigenous Flora) have been introduced. They are, many of them, English weeds, and are increasing with such rapidity as to threaten the native plants with extirpation.

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2nd.—Another group, generally fresh-water species, are widely dispersed by the agency of birds. For an illustration of this phenomenon we may again refer to the New Zealand Flora. Twenty-two of the native plants of the Canterbury Province are common English species, and of these eighteen are fresh-water and three littoral forms.

3rd.—Another group, chiefly littoral forms, are dispersed by the agency of ocean currents.

4th.—Allowance having been made for the three preceding modes of dispersion, there still remain a large majority of which the only explanation that can be given is that they have travelled over continuous land. It is to these that we must look for information as to the former oscillations of land and water.

Before leaving the New Zealand Flora it will be interesting to note some remarkable features which it presents and which show the extreme differentiation of an insular Flora, as distinguished from a continental one. Of the 750 flowering plants in the Canterbury Province, 588 are restricted to New Zealand. The number of genera of flowering plants and ferns is 275, and of these no fewer than 109 have only one species each. Of 857 species of flowering plants and ferns, 176 are Australian and 108 American, showing former connection with these continents, but very long separation.

The history of the more recent geological changes in its bearing upon the distribution of plants on the European Continent is of the highest interest. We know, from the evidence of their fossil remains, that in Miocene times a large assemblage of plants of a tropical or sub-tropical character covered the land of the northern hemisphere from the Tropic of Cancer to within ten degrees of the Pole. Palms, figs, and laurels grew on the site of the Lake of Geneva, and the plane, tulip-tree, walnut and vine, together with the Sequoia and Magnolia, flourished in Greenland. After Miocene times there was a gradual decline of temperature, which culminated in the refrigeration of the glacial epoch, and this again has been succeeded by the climatic conditions of the modern world. Simultaneously with these variations of temperature were oscillations in level of many thousand feet, and corresponding changes in the boundary of sea and land. Now consider what must have taken place as the climate gradually became colder. The plants in any given zone of latitude would be sorted by the increasing cold. Those unsuited to the colder climate would be driven to the zone below, where they would find their proper temperature, but

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be subjected to new conditions of various kinds. The hardier species would remain behind, but their interactions would be changed and they would be affected by migrations from the zone above. The effect would be a migration southwards of a vast numbers of species. When the European stream reached the foot of the Alps it would divide into two branches, the one travelling into France and Spain, the other into Hungary, Turkey, and the Levant. At the same time with these migrations the Alpine species would descend from the mountains into the plains. As the climate grew warmer the migrations would continue but their direction would be reversed. The southern species would return northward, the Alpine species would travel partly to the mountain summits, partly to the Arctic zone. During the glacial epoch there was a great submergence, by which many of the plants of northern Europe must have been destroyed. These changes must have produced large specific modifications in the European Flora, and account for many of the singular phenomena of distribution which it presents.

We observe, for instance, striking differences between the Floras of the east and west end of the Alps, small groups of remarkable species restricted to areas of very limited dimensions, single species appearing in a few spots widely distant from each other, such as the Welsh Poppy in Wales, Central France and the Pyrenees, or restricted even to a single locality, as *Wulfenia carinthiaca* to one mountain in the eastern Alps. On the other hand, we find plants restricted to a few localities, but very widely distributed, strangely incapable of colonising the intervening spaces, even when provided with the feathery pappus of composites, such as *Hypochœris maculata*, and some of the Hawkweeds. Finally we have the Alpine Flora, characteristic of the higher summits of the Pyrenees, Alps, Carpathians, Altai, and Caucasus, and reappearing to a great extent both in the Old and New World, within the Arctic zone.

The origin of this Flora and the nature of its connection with that of the Arctic zone is a question of great interest which has been discussed with signal ability by Mr. John Ball.* Sir J. D. Hooker was of opinion that the Alps had been colonised from the Arctic regions; Mr. Ball, with more justice, as it seems to me, holds the view that the Arctic regions were colonised from the Alps.

The genus most characteristic both of the Alps and Arctic regions is certainly the saxifrage. Its distribution in Europe

* Proceedings Royal Geog. Soc., New series, vol. 1, p. 564.

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is as follows:—The Scandinavian species are fourteen in number. Of these all but two are in the Alps, all but four in the Pyrenees, and almost all are North American. The Alpine saxifrages number forty-four, of which twelve only are Scandinavian, while twenty-five are Carpathian, twenty Pyrenean, and eight Altaic.

Mr. Ball points out that of 1,157 species characteristic of the Alpine Flora, two-thirds are found in the Carpathians, one-half in the Pyrenees, and one-fourth in the Altai.

When we pass to the south of the Mediterranean the contrast is amazing, the entire Algerian Atlas yielding seven species only of Alpine plants.

The Flora of our own country, although of comparatively small interest, owing, as I believe, to the destruction of the greater part of the indigenous plants at the time of the submergence in the glacial age, presents, nevertheless, some curious features.

The total number of species is 1,665; of these, 1,465 are Germanic or Scandinavian, the majority of which are scattered over the whole of northern temperate Europe and Asia.

They may be subdivided into plants widely spread in Britain, Germanic plants confined to the eastern side of England, mountain plants (Scandinavian or Alpine).

Deducting aliens and uncertain segregrates, we have left 119. Of these, 114 are species belonging to south-west Europe and three are American. It is worthy of remark that there does not exist throughout the whole extent of the British Isles a single well-defined endemic species.

A few words upon one of the most curious points connected with the distribution of plants, and these remarks must be brought to a conclusion. I refer to the contrast which different genera present in their capacity for receiving specific modifications under the influence of varying external forces. On the shores of the Mediterranean the bramble is almost stable; the only form that is met with, or nearly so, is *Rubus discolor*. In the northern part of temperate Europe its variations are very numerous. On the other hand, the genus *Medicago* is nearly stable in the zone of *Rubus*, and highly plastic on the Mediterranean coasts. *Astragalus* presents differences still more remarkable than those of *Medicago*. In England there are only three species, in France twenty-four, in Spain thirty-nine; while Boissier, in his "Flora Orientalis," including only the extra-tropical countries from Greece to the borders of India, enumerates no fewer than 757 species.

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ANTHROPOLOGY, ITS MEANING AND AIM.

BY JOSEPH SMITH, JUN., M.A.I.

(Continued from page 325.)

The change of climate to mildness has a tendency to reduce the size of the body, and it will be found on comparison that the bones from the early sepulchres, when a cold climate has been known to exist, are of greater proportions than those of beings dwelling in the same place during a warmer temperature.

The skull of an infant is soft, and is capable of being moulded into any form before solidifying takes place. If consideration is taken of the innumerable and adventitious causes which come into operation, and influence the formation of the skull, you will no longer be able to wonder at the variety of form presented by the human cranium, even amongst those belonging to our own nation. Sleeping on the back gives a compressed occiput, and by lying on one side you have an elongated skull. Hippocrates ("De aer., aqu., et loc.," 35,) states that after artificial shaping of the skull has taken place for a very long period, a kind of natural degeneration is observed, and the means previously adopted for obtaining this form are no more a necessity, since the skulls grow of their own accord to the form acquired.

Anthropologists have been labouring strongly to establish some recognised method of measurement, the result of which is that Retzius's division has been further divided and improved, the skull indices for the measurement of capacity being as follows :—

LENGTH AND BREADTH INDEX.

$$\frac{100 \times \text{breadth}}{\text{length}}$$

Dolichocephalic (long skull)	below 75·0
Mesocephalic	75·1 to 79·9
Brachycephalic (short skull)	80·0 „ 85·0
Hyperbrachycephalic	85·1 and over.

LENGTH AND HEIGHT INDEX.

$$\frac{100 \times \text{height}}{\text{length}}$$

Chamæcephalic (flat skull).....	75·0 and under
Orthocephalic	70·1 to 75·0
Hypsicephalic (high skull).....	75·1 and over.

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Profile Angle.

This, which is the inclination of the profile line to the horizontal plane, is classed under the three following divisions :—

1.—Prognathous ...	82° and under
2.—Mesognathous, or Orthognathous	83° to 90°
3.—Hyperorthognathous	91° and over.

Facial Index—*(Virchow)*.

$$\frac{100 \times \text{height}}{\text{length}}$$

The breadth of the face considered as the linear distance between the two jugo-maxillary sutures (as also the facial index of Von Holder).

Broad-faced skull	90·0 and under
Narrow-faced skull	90·1 and over.

Index of the Upper Face—*(Virchow)*.

$$\frac{100 \times \text{upper facial height}}{\text{facial breadth}}$$

Facial breadth considered as a linear distance between the two jugo-maxillary sutures and the upper facial height.

Broad upper face	50·0 and under
Narrow upper face	50·1 and over.

Zygomatic Facial Index—*(Kollman)*.

$$\frac{100 \times \text{facial height}}{\text{zygomatic breadth}}$$

The greatest distance between the zygomatic arches, and the facial height, divided into two classes.

Low-faced chamæprosopic skull, from προσωπον, meaning "face"	90·0 and under
High-faced leptoprosopic skull	90·1 and over.

Zygomatic Upper Facial Index—*(Kollmann)*.

$$\frac{100 \times \text{upper facial breadth}}{\text{zygomatic breadth}}$$

Chamæprosopic upper face with an index of 50·0 and over.
Leptoprosopic upper face with an index of 50·1 and over.

The upper facial index acts as a control measurement to the facial index. It is important to ascertain it in cases where, through the absence of the lower jaw, the facial index cannot be determined.

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Orbital Index.

$$\frac{100 \times \text{orbital height}}{\text{orbital breadth}}$$

Chamækonchous	80·0 and under
Mesokonchous	80·1 to 85·0
Hypsikonchous	85·1 and over.

Nasal Index.

$$\frac{100 \times \text{nasal breadth}}{\text{nasal height}}$$

Leptorhine	47·0 and under
Mesorhine	47·1 to 51·0
Platyrhine	51·1 ,, 58·0
Hyperplatyrhine	58·1 and over.

Palatal index of Virchow only provisional, and as yet is not adopted.*

Colour plays a great part in the natural history of man, and although it is not a subject I am here going to enter on, still a few words thereon may not be unacceptable. It is well known that white men, when dwelling for a considerable time in torrid zones, lose an amount of whiteness and assume a brownish tinge, sensibly verging to black, with much more facility; and there is ample mention in the observations of travellers that "on the black attaining his séventieth year" there is a great tendency to a lighter colour, for at that age the reticulum sensibly loses a portion of its colour, causing the hair and beard to assume at first a straw and then a white tinge; and infants brought to a colder climate while young lose a quantity of their black colour, and assume a tinge more approaching brown. Blumenbach, in his memoirs, states that he himself knew a mulatto woman, born of an African father and white mother, who in her youth was sufficiently brown, but who by a residence in a colder clime and through time, had so degenerated in this respect that she retained only a cherry or tawny-coloured skin; and he also asserts that a colony of Portuguese ("Rech. sur les Americ," i., p. 166,) who were carried to Africa in the fifteenth century, have now assimilated the native colour to such an extent as to be scarcely distinguishable from the aborigines. Thus it will be seen that climate is accountable to a great extent for the variation of colour tint in the different nations. The varieties will be apparent in

* These measurements are extracted from the remarks of J. G. Garson "On the Frankfort Craniometric Agreement" in the "Journal of the Anthropological Institute of Great Britain," vol. xiv., p. 66, &c.

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the offspring of unions of different tints, and this principle may be accepted, that in these cases the more opposite and contrary colours so degenerate that white men may sensibly pass into black men, and the reverse. Hybridity, if such term may be applied to this feature of Anthropology, is, as seen from the foregoing, a very important principle, as by it such varieties of colour are attained; and a feature which must not be omitted is that the fecundity of the descendants of the issue of these hybrid unions is superior to that of men and women of the same colour, a circumstance which, in the economy of Nature, will in a period of time have much effect on the variety colour of a race. These offsprings are distinguished by class names, arranged by Blumenbach as follows:—

The issue of a black man and white woman, or black woman and white man, is called Mulatto, Molaka, and Meletta; in Italian, Bertin, Creole, and Criole; in the Malabar language, Mestico. The issue of an American man and European woman is a Mameluke, or Metif; from an European male and a Mulatto female comes a Terceron, Castiça. The son of an European female by a Metif is a Quateroon; the issue of two Mulattos is a Casque; and of Blacks and Mulattos, Griffs. A Terçeron female and European produce Quateroons, Postiços; and the American Quateroon (who is equal to the Black Terçeron), produces from an European, an Octavoon. The issue of a Quateroon male and a white female is a Quinteroon; and the child of an European woman from an American Octavoon is, in Spanish, Puchuela; and so as these various grades marry and intermix, the progress from lighter to darker, and *vice versa*, can very easily explain away some of the difficulties regarding the variation of colour. Then there must be considered those curiosities, if the term be allowed, which present themselves in all anthropological investigations, but which do not form any part of the present paper. I refer to spotted men, wild men, Leucæthiopians, Nyctalopes, &c. These offer interesting investigations, but their study belongs rather to the physiologist than to any other.

The preceding are some of the features or factors, which enter into and form part of that study which has for its object the investigation of the most perfect creature of the Creator. From these it will be seen how grand and extensive is the range of Anthropology, how broad is its meaning, and how ennobling is the aim of the science.

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SOME INACCURACIES UPON THE GEOLOGICAL SURVEY MAPS AND SECTIONS OF THE LEICESTERSHIRE COAL-FIELD.

Having been in a position to verify portions of the one-inch Geological Survey maps and some of the vertical and horizontal sections of the coal district between Ashby-de-la-Zouch and Burton-on-Trent, I think the errors discovered in them should be made known, so that those interested in the geology of the locality may not be misled.

(a) Taking the *one-inch map* first, on quarter sheet 63, N.W.

i.—At one mile to the S.E. of Overseal village, where the word "Derbyshire" occurs, there is an exposure or out-crop of the Permian "brecciated conglomerate."

ii.—The Fault marked as running for a distance of nearly one mile from the E. end of the reservoir on Ashby Woulds in a N.W. direction is entirely wrong; the white line should have gone in a N.N.E. course from "Hanging Hill," near Moira, towards "Wooden Box" (Woodville, as the place is now usually called).

iii.—On quarter sheet No. 71, S.W., the Fault shown as running N.W. and S.E. at about half a mile to the E. of Swadlincote Railway Station is in reality only about a quarter of a mile from that station.

Other minor errors might be mentioned as having been made upon these two maps were it necessary to do so.

(b) Upon the *Horizontal Sections*, Sheets Nos. 49 and 52, I notice the following inaccuracies. Upon No. 52 in Section 2, the fifth Fault from the commencement of the Section in the W. is a downthrow to the W., and not to the E. as marked. On sheet No. 49 in Section No. 2, the Permian rocks shown about the middle of the Section near "Norris Hill" have not been coloured as such.

(c) With regard to the *Vertical Sections*.—Taking sheet No. 20 (Leicestershire Coal-field, Moira district).

No. 2 Section.—The water referred to as being large in quantity in certain of the strata does not naturally exist in the measures, but proceeds (or rather when the shafts of this colliery were sunk, proceeded) from old drowned-out main-coal workings situated to the S. or rise side of the "Oakthorpe New Colliery."

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No. 3 Section.—For "Hastings and Grey Shafts," read "Newfield Shafts." (See No. 4 Section.)

No. 5 Section.—The following beds of coal have been emitted :—

At	23ft. 4in.	from the surface	a coal	2ft. 2in. thick.
At	78ft. 2in.	,, ,,		1ft. 8in. ,,
At	120ft. 0in.	,, ,,		1ft. 1in. ,,
At	125ft. 6in.	,, ,,		,, 5in. ,,
At	167ft. 6in.	,, ,,		,, 5in. ,,

As these five coal-beds were sunk through in the year 1821, they must have been either overlooked or accidentally left out when the Survey sheet was compiled.

No. 6 coal-seam of this (No. 5) Section is incorrectly given. The two uppermost beds bracketted under "over" should have been left out, the actual thickness of the seam of "main coal" being 12ft. 3in., not 14ft. 2in. as given.*

Nos. 6, 8, and 13 Sections.—The coal-seams named "Slate," "Woodfield," "Stockings," and "Eureka" should have been numbered 4, 3, 2, and 1 respectively in descending order.

No. 9 Section.—For "Mr. Healy," read "Mr. Eley."

W. S. Gresley, F.G.S.

MIDLAND UNION OF MICROSCOPICAL AND NATURAL HISTORY SOCIETIES.

At a Meeting of the Management Committee of the Union, held on Nov. 11th, it was resolved to accept the joint invitation of the Caradoc Field Club, the Oswestry and Welshpool Field Club, and the Shropshire Archæological Society, for the Meeting of the Union in Shrewsbury, in 1886. A central Executive Committee and Local Secretaries (the Revds. O. M. Fielden, of Oswestry, and T. Auden, of Shrewsbury) have already been appointed, and the Meeting in such an interesting town, with such a grand field for excursions, can hardly fail to be specially enjoyable. The exact date of the Meeting cannot be fixed at present.

It was also resolved that an attempt should be made so to modify the arrangements for the necessary business of the General Meeting as to make room for a few short papers on

* The above particulars in reference to No. 5 Section are from the original account of the strata sunk through in the year 1821.

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any subjects which may appear desirable. It was considered that by this means more particularly matters of interest in regard to the next day's excursions might be of service.

The Committee also had under its consideration the arrangements for the award of the Darwin Medal, which were referred to it for amendment by the Council at the Meeting last June. The paragraph which defines the papers eligible for the prize will now stand :—

"The Darwin prize is to be awarded to the paper, *or set of papers by the same author*, of highest merit which has been sent in since the expiration of the last term for which a prize was awarded for that subject."

Thus any paper, or set of papers in zoology, sent in between March 31st, 1882, and March 31st, 1886, will be eligible for the Darwin prize for 1886.

It will be seen that the alteration consists in inserting the words "or set of papers by the same author," doubts having arisen as to the powers of the adjudicators in this particular.

Another paragraph was adopted, viz. :—"The Council shall in any year withhold the Darwin Medal, in case the majority of the adjudicators report that the papers submitted to them are not of sufficient merit to deserve it."

THE EAR AND HEARING.

BY W. J. ABEL, B.A., F.R.M.S.

(Continued from page 285.)

The estimation of *distance* and *direction* of sounding bodies is a purely intellectual operation—the result of inference from intensity of sensation, &c.

The *perception of distance* and direction is only acquired by experience. Sensations of touch are localised only after multiform experience of the difference in the degree of the sensations excited in various spots. It is the same with hearing; we judge of the distance and direction of the sound by the kind of impression produced. If a sound is already known to us, as in the case of the human voice, we judge its distance by the feebleness of its impression upon the nerve of hearing. If the intensity at a given distance is unknown, as for example, thunder, we suppose it nearer according as it is louder. The rumbling of a waggon in the street is thus often mistaken for distant thunder, and *vice*

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versa. We thus see how inferential processes control our judgment of distance. If we are led to imagine a sound is farther off than it really is we seem to hear it stronger than it is. Awaking suddenly in the night we hear a faint noise and suppose it much louder, through our temporary confused notion of its real distance. Hence the slight creak of a part of the bed or bed room furniture, the gnawing of a mouse or beetle, &c., originates in timid and imaginative subjects ideas of ghostly and burglarious sounds.

It being an effect of distance that sounds fade away into a feeble hum, when we encounter a sound whose natural quality is feeble, like the hum of a bee, we readily imagine it more distant than it really is. Hence also the possibility of ventriloquism. The ventriloquist modifies his voice to imitate sounds proceeding from varying distances and places, and also tends to impose upon our judgment, through the effects of imagination, by directing his voice to various points, pretending himself to hear the sounds proceeding from thence. Must we then implicitly "believe our own eyes and ears"?

Our estimation of *direction*, according to our present knowledge, appears to be owing to a process of reasoning applied to the sensation. Thus we hear distinctly a sound emanating from a given point, whatever position the head is in; but, the ear being able to judge of slight differences in the intensity of sounds, we remark that in certain positions of the head the sound seems strongest. We are hence led to place our head in one fixed position as regards the sounding body—that is, the one which shall bring the external meatus as nearly as possible in a straight line with the sounding body. Our sight tells us what is this direction of most perfect hearing, and we then apply the observation made upon bodies that we can see to those that are not seen. The combined action of the *two ears* also favours very materially the perception of direction of sound—as our two eyes do visual perceptions. A person deaf in one ear is usually unable to say whether a sound proceeds from before or behind. According to Weber, in determining the direction of sounds we employ the external ear for those coming from above, below, behind, before; and the tympanum for those coming from left to right. He inserted the head in water, the air passages being filled with air so that the tympanum was free to vibrate, and found that in that case the ear recognised sounds as external, but could only distinguish them as proceeding from the right or left. When, farther, the ear itself was filled with water, and

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the free action of the tympanum arrested, the sense of externality was quite lost, and the feelings of sound regarded as subjective.

The sense of direction is by no means very delicate, even after being educated to the full. We can readily recognise whether a voice at about the level of our ears is before or behind, to the right or left, up or down; but if we were to stand opposite a row of persons at a distance of, say, ten feet, we should not be able to say, unassisted by sight, &c., which one uttered a sound, as schoolmasters well know. So it is almost impossible to find out a skylark in the air from the sound of its song. A simple experiment illustrating the uncertainty of our sense of direction of sounds may be performed by blindfolding a person seated in a chair, and clicking two coins opposite various parts of his body within reach of his arms, requiring him to point to the exact locality whence the sound proceeds. Some people will be found to err greatly in their estimates. In his opening address, at the recent meeting of the British Association, Lord Rayleigh remarked upon the imperfect state of our knowledge of the means whereby we recognise the direction of sounds, and stated that it has been proved that, when proper precautions are taken, we are unable to distinguish whether a pure tone, as from a vibrating tuning-fork held over a suitable resonator, comes from before or behind, as might have been expected from an *à priori* point of view, but, what would not have been expected is, that with almost any other sort of sound, from a clap of the hands to the clearest vowel sound, the discrimination is not only possible, but easy and instinctive. In these cases it does not appear how the possession of two ears helps, though there is some evidence that it does; and even when the sound comes to us from the right or left the explanation of the ready discrimination which is then possible with pure tones is not so easy as it first seems. We should be inclined to think that the sound is heard much more loudly with the ear turned towards it than with the ear turned from it, and that in this way direction is recognised; but if we try the experiment we find that, at any rate with notes near the middle of the musical scale, the difference of loudness is by no means so very great. The wave-lengths of such notes are long enough in relation to the dimensions of the head to forbid the formation of anything like a shadow in which the averted ear may be sheltered. In such cases I should myself be inclined to look for the power of discrimination rather in slight qualitative differences in the effect of given stimuli according as they affect more

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directly the right or left branch of the auditory nerve, but I am fully aware of the objections which may be urged to this, and simply quote it as a surmise. The localising of the sensation I think, with Bain, to be due to the distinct central endings of the nerves from the two ears. In his words "Given the nerves distinct, sensations may be absolutely identical as feelings and yet quite distinct for intellectual purposes" [owing to their connection with different brain cells].

The diffused bodily movements and sensations frequently accompanying irritation or excitement of the auditory nerve, *e.g.*, the sudden start, winking, and general shock somewhat like that produced by an electrical discharge, caused by an intense and sudden noise, the thrilling grating sensation in the teeth, and cold trickling feeling caused by such sounds as those produced in saw sharpening, &c., may be adequately explained by the results of antipathies, and the operation of what Herbert Spencer calls the law of nervo-motor-action, which states that every feeling (including sensation) has for its primary concomitant a diffused nervous discharge which tends with varying degrees of force to excite the muscles to action, the degree and extent of energy in the resulting bodily movements varying directly as the intensity of the feeling, and affecting the muscles of the body in the inverse order of their sizes and the weights of their attachments. The pain caused by certain sounds seems again explicable, as is that accompanying other sensations, by excessive nervous stimulation, or wasting conflict between adverse nervous currents.

METEOROLOGICAL NOTES.—October, 1885.

Atmospheric pressure was very variable during the month, and the changes numerous and rapid. The highest morning reading was on the 17th, 30·189 inches; the lowest, on the 26th, 29·027 inches. The mean temperature was about four degrees below the average. The highest maxima were 62·4° at Loughborough, on the 16th; 60·0° at Henley-in-Arden, on the 3rd, 8th, and 17th; 59·0° at Coston Rectory, on the 1st and 16th; 57·9° at Hodsock, on the 2nd; and 57·0° at Strelley, on the 3rd. In the rays of the sun, 115·1° at Hodsock, on the 5th; 113·8° at Loughborough, and 104·7° at Strelley, on the 3rd. The lowest minima were 25·0° at Coston Rectory, on the 12th; 27·3° at Hodsock, 29·3° at Loughborough, 30·5° at Strelley, on the 30th; and 31·0° at Henley-in-Arden, on the 12th and 30th. On the grass, 20·2° at Hodsock, 21·8° at Strelley, and 26·4° at Loughborough, on the 30th. The rainfall was unusually heavy, the totals being 6·34 inches at Coston Rectory; 6·01 inches at Strelley; 5·62 inches at Loughborough; 5·32 inches at Hodsock; and 4·51 inches at Henley-in-Arden. These values were

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distributed over from 21 to 24 days. The amounts measured in 24 hours were exceptionally large, particularly on the 23rd, when 1·67 inches were registered at Hodsock; 1·56 inches at Strelley; 1·54 inches at Coston Rectory; and 1·24 inches at Loughborough; 0·75 of an inch at Henley-in Arden, on the 6th. Sunshine was about the average. High winds prevailed generally through the month.

WM. BERRIDGE, F. R. Met. Soc.
12, Victoria Street, Loughborough.

THE FLORA OF WARWICKSHIRE.

AN ACCOUNT OF THE FLOWERING PLANTS AND FERNS OF THE COUNTY OF WARWICK.

BY JAMES E. BAGNALL, A.L.S.

(Continued from page 295.)

CRYPTOGAMIA.

ACOTYLEDONS.

FILICES.

POLYPODIUM.

P. vulgare, *Linn. Common Polypody.*
Native: On mossy banks, on the branches of old trees, and rarely on old walls. Locally common. June to October.
I. Sutton Park; Coleshill Heath; lanes about Maxtoke and Fillongley; Marston Green, Olton Lane; lanes about Knowle, Solihull, Honiley, Shirley, and Hockley; Forshaw Heath.
II. On a bank near Meriden Church, *Kirk, Phyt.*, ii., 809; near Norton Lindsay, *Perry, Phyt.*, i., 510; lanes about Allesley; Corley; Tile Hill; lanes about Baddesley Clinton; Rowington.

OSMUNDA.

O. regalis, *Linn. Royal or Flowering Fern.*
Native: In bogs and on river banks. Very rare. July.
I. Moist banks by the new park, Middleton, *Ray, Gough's Camb.*, ii., 350; bog at Coleshill Pool, *Bree, Purt.*, ii., 518.* Found formerly at Coleshill Heath and other places, but I cannot find it now. Sutton Park, as I am informed, but very sparingly, *Bree, Phyt.*, i., 511. Extirpated in Sutton Park many years since. It has been recorded from near Marston Green and by the Blythe, near Coleshill, but on uncertain authority.

* "It must be near thirty years ago that I saw and gathered a single specimen, and that a weak one, of Lycopodium selago, and also of Osmunda regalis, in the bog below Coleshill Pool; but repeated search has never subsequently been rewarded by another specimen of either plant in that situation."—*Bree, Mag. Nat. Hist.*, v. 199, 1832.

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OPHIOGLOSSUM.

O. vulgatum, *Linn. Common Adder's Tongue.*
Native: In pastures, meadows, and peaty heath lands. Local. May, June.
I. Elmdon, *Cameron;* Maxtoke, *Bree;* meadows near the Rectory, Sheldon, *Jackson, Anal.* vi.; Middleton. near the Hall; heath land near Bannersley Pool; in several meadows and pastures near Knowle; meadows near Blythe Bridge, Solihull.
II. Meadows near Leamington; plantations near Saltisford Common; field near Baly's Locks, *Perry, Fl.* 81; Allesley, *Bree;* in fields near Emscote Cotton Mills, *Baynes*; meadow at Offchurch; near Woodloes and Goodrest, Warwick Old Park; Whitnash Field, *Murcott*; Eastern Green, *Baly, Phyt.* i., 512; near Harborough Magna, *Blox.*; Harbury; Kenilworth, *Y. and B.*; Honiley, *H.B.*; Chadshunt; Gaydon, *Bolton King*; Honington Bridge! *F. Townsend*; pasture by Exhall Hall, Coventry, *Mrs. Browett.*

BOTRYCHIUM.

B. Lunaria, *Sw. Moonwort.*
Native: In old pastures and waste heaths. Very rare. May, June.
I. In a close at Sutton Coldfield Park, *Ray, Cat.*, 199; on heathy ground near the upper part of Coleshill Bog, *Murcott, Phyt.* i., 511; near Knowle Railway Station! *W. G. Blatch*; heathy meadows near Middleton.
II. Old pasture on Oversley Hill, *Rufford, Purt.*, ii., 518; Lighthorne (now extinct), *Bolton King.*

LYCOPODIACEÆ.

LYCOPODIUM.

L. clavatum, *Linn. Common Club-Moss.*
Native: On heaths. Very rare. July.
I. Coleshill Heath, *Bree. Purt.* ii., 520; Coleshill Bog, *W. Southall, Phyt.* i. 512; Sutton, *Freeman, Phyt.* i. 262; Meriden Heath, *T. Kirk.*; Sutton Park, 1884, *Miss Ethel Stone.*

L. inundatum, *Linn. Marsh Club-Moss.*
Native (?): On marshy heaths and near pools. Very rare. July.
I. Coleshill Heath formerly, *Bree;* near the upper end of Coleshill Pool in 1842, Murcott, *Phyt.* i., 512.

L. selago, *Linn. Fir Club-Moss.*
Native (?): In bogs. Very rare. April to October. Bog at Coleshill Pool, *Bree. Purt.* ii., 522.*

MARSILEACEÆ.

PILULARIA.

P. globulifera, *Linn. Pill-wort.*
Native: On the shores of pools. Very rare. June to August.
I. At Coleshill Pool, where I have found it covering the shore to a great extent! Purt. ii., 519; abundant near Bracebridge Pool in two or three spots, 1876-80; abundant at Coleshill Pool as late as 1881.

* An interesting account of the Lycopods of Warwickshire is given by the Rev. W. T. Bree, in *Phyt.* i., 61, from which it will be seen that none had been seen by him for many years in the localities cited.

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EQUISETACEÆ.

EQUISETUM.

E. arvense, *Linn. Corn-field Horsetail.*

Native: On damp heaths, heathy roadsides, banks and fields. Common. March, April. Area general.

E. maximum, *Linn. Great Water Horsetail.*

Native: Near rivers and in damp places and woods. Rare. May, June.

I. In a marshy copse, Edgbaston, *W. Southall*; Kingsbury Wood, abundant; Bentley Park, near Atherstone, abundant, 1883-84.

II. River Avon; Nicholas Meadow, *Perry Fl.*, 80. In a marshy situation; Arbury Hall! *Kirk Phyt.* ii., 810; Wroxall, *Y. and B;* Pit near Lawford Road, Rugby, *Blox. R.S.R.*, 1867; abundant, canal siding near Ansty, 1884.

E. sylvaticum, *Linn. Wood Horsetail.*

Native: In woods and damp pastures. Rather rare. April, May.

I. About and in New Park! Middleton, near Tamworth, *Ray Cat.*, 100; near Botanic Gardens, *W. Southall, Phyt.* i., 511; near Elmdon, *Cameron, Phyt.* i., 555; Trickley Coppice, Middleton; Kingsbury Wood; Bentley Park, near Atherstone; Frogmore Wood, near Temple Balsall; Earlswood Reservoir.

II. Boggy ground in Grafton Field, *Purt.* i., 501; on the borders of a wood, and in a cornfield near Arbury Hall, *T. Kirk, Phyt.* i., 972; near Norton Lindsay, *H. Bromwich*, Burton Green; Kenilworth, *Y. and B.*

E. palustre, *Linn. Marsh Horsetail.*

Native: On damp heaths, in marshes and on other damp places. Local. June to September.

I. Elmdon, *Southall; Phyt.*, i., 512; Sutton Park; near Bannersley Pool; Coleshill Pool; near Solihull; Earlswood.

II. Exhall, *Purt.* ii., 501; boggy field at Norbrooke, *Perry Fl.*, 80; near Budbrook Field, Warwick, *Perry;* meadows at the Woodloes! and Bubbenhall; Stoke, *Baly Phyt.*, i., 512; near Harborough Magna, *Blox. M.S.;* old canal between Newbold and Little Harborough! pond near Cawston, *R.S.R.*, 1877; Beausale! *Y. and B.*

E. limosum, *Linn. Smooth Naked-horsetail.*

Native: In pools, marshes, rivers, and canals. Rather local. June to September.

I. Coleshill Pool! mill pool, Bristol Road, *Cameron;* Bannersley Pool! *Murcott Phyt.*, i., 512; Sutton Park! Middleton Pool, near Tamworth; Kingsbury; Bentley Park, near Atherstone; Oldbury Reservoir; Seas Pool, Arbury; Olton Pool, near Solihull; Earlswood.

II. Studley, *Purt.*, ii., 510; windmill field, near Haseley, *Perry Fl.*, 81; St. Nicholas' Meadow, Warwick; Chesterton Mill Pool! near Oldham's Mill, Leamington, *Perry;* several pits in Warwick Old Park, *Murcott Phyt.*, i., 512; Wroxall, *Y. and B.;* Sowe Waste Canal.

b. fluviatile, Linn. Rather rare.

I. Copse, near Elmdon, *Cameron Phyt.* i., 555; Sutton Park; ditches, Kingsbury; near Bentley Park; Oldbury Reservoir; Seas Pool, Arbury; near Solihull; near Shirley; Earlswood Reservoir; pool, near Forshaw Park.

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II. Old Park, *Y. and B.;* Sowe Waste Canal; pool, near Till Hill Wood.

This does not seem to be more than a form or state of *E. limosum.*

E. hyemale, *Linn. Rough Horsetail.*

Native; In ditches. Very rare. 7, 8.

I. In a moist ditch at Middleton, towards Drayton, *Ray. Gough's Camb.*, 350.

I have examined all the ditches near and about Middleton, but have not been able to find this plant.

CHARACEÆ.

CHARA.

C. flexilis, *Linn.* (Nitella). *Flexible Chara.*

Native: In ponds and pools. Rather rare. June to September.

I. In the third stew, front of the house at Edgbaston, *With., Ed.* 3, 4; abundant in a pool near Hartshill, 1884, Olton Pool; 1881 in company with Mr. James Groves, abundant in a pond near Olton Pool; Earlswood Reservoir; abundant in a small pool on Forshaw Heath.

II. Ditches about Drayton, *Purt.* ii., 435; in a pond near Warwick, *H. B.;* canal, near Ansty.

C. opaca, *Ag. Syt. Alg. Opaque Chara.*

Native: In ponds and pools. Rare. May to September.

I. Sutton Park, in Bracebridge Pool and Stews; pool, by Honily Poors Wood; Dickens, near Earlswood; 1883.

C. translucens, *Ag. Syt. Alg. Great Translucent Chara.*

Native: In ponds and ditches. Very rare. June.

II. In ponds and ditches, near Rowington, *H. Bromwich.*

I have not been able to find this plant in this district, or in any part of the county. It is many years since it was found, and as these plants were then little understood may be incorrectly named.

C. vulgaris, *Linn.* (Chara). *Common Chara.*

Native: In pools, ponds, ditches, canals, &c. Local. May to September.

Var. *A. vulgaris.* Apparently rare.

I. Bracebridge Pool, Sutton Park; Kingsbury Wood.

II. Pond, near Chadshunt.

Var. *B. longibracteata,* Kütz. More frequent, but local.

I. Drains, Water Orton; Earlswood Reservoir.

II. Corley Heath, *Kirk.;* small pool, near Chadshunt; ditches, near Harbury Railway Station; small pool, near Drayton Bushes; pool, near Stratford-on-Avon; canal, near Bishopton and Wilmecote; pool, near Napton-on-the-Hill; Napton Reservoir; Flecknoe, near Shuckburgh; old lime quarry, near Little Lawford; canal, near Newbold-on-Avon; canal siding, Ansty.

Var. *c. papillata,* Wallr. Very rare.

II. Cattle pond, near Itchington Holt.

A form closely allied to this was abundant in a pit near Little Lawford, almost choking up this pit with its growth; two years later I again visited the same pit, and found that although there was an abundance of the var. *longibracteata,* not a trace remained of the *papillata* form. The plant from Itchington Hall disappeared entirely after the first year, and was also replaced by the variety above cited.

E. crassicaulis, Kütz. Very rare.

II. "Coventry Park, near Coventry, *T. Kirk., Herb. Brit. Mus.*" A Review of British Characeæ, H. and J. Groves, p. 13.

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C. contraria, *Kutz.*
Native: In pools and canals. Very rare. July.
II. Canal and pool near canal, Sowe Waste.
C. fragilis, *Desv. Brittle Chara.*
Native: In pools and canals. Rare. May to September.
I. Earlswood Reservoir; 1883, Oldbury Reservoir, abundant; near Bolehall, Tamworth, in streams, abundant.
Var. *Hedwigii*, Ag. Rare.
I. Canal, near Knowle, 1870; Spring Pool, Kenwalsey, 1883.
II. Near Harborough Magna, Blox, *M.S.*; canal near Shrewley tunnel on the way for Rowington.
Var. *capillaceæ*. Thuill. Rare.
I. In pools and marshes Sutton Park.

All the species and varieties of this group of plants collected by myself have been submitted to our best authorities on the Characeæ, Messrs. H. and J. Groves, and I am greatly indebted to them for kindly help.

Natural History Notes.

PUCCINIA SONCHI, Desm.—I am glad to be able to state that *Puccinia Sonchi* has again made its appearance at Hamstead, the only locality as yet recorded for it in Britain, and where it was first found in the autumn of 1884. It is still in the uredo stage, as described by Mr. Grove in the "Midland Naturalist" and "Science Gossip." While it is to be hoped that this fungus will establish itself as a permanent addition to our flora, it should nevertheless be sought for in other localities, as the sonchus upon which it occurs is being gradually exterminated (probably by rabbit fanciers), few plants being now left where they were once abundant.—H. HAWKES.

GUIDE TO THE GEOLOGY OF LONDON.—It is not usual to find a Geological Survey Memoir running through as many editions as a popular novel, but this appears to be the case with Mr. Whitaker's excellent work on the Geology of London, of which the fourth issue has just reached us. Clearly written, carefully revised, and sold at the low price of one shilling, it is a model for all similar works.

DEEP BORING AT KING'S HEATH, NEAR BIRMINGHAM.—The depth of this boring, now being executed by Messrs. Le Grand and Sutcliff, has been increased to 561 feet, with the result that it continues in the Triassic red marls. The gypsum is still present; 350 feet of gypseous beds having now been penetrated.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—GENERAL MEETING, November 3rd. Mr. J. E. Bagnall, A.L.S., exhibited for Mr. J. B. Stone, J.P., the following mosses: *Amblystegium irriguum, Hypnum crassinervium, H. falcatum*, &c. Mr.

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W. H. Wilkinson exhibited *Schœnus ferrugineus*, one of the bog rushes, a plant new to Great Britain, recently found by Mr. J. Brebner in Scotland. Also from Dr. F. Buchanan White, F.L.S., *Utricularia vulgaris*, *U. intermedia*, *U. minor*; the single-leaved strawberry, *Fragaria vesca* v. *unifolia*; *Polypodium alpestre* v. *flexile*, *Polystichum Lonchitis*, and *Woodsia ilvensis*; also the blue daisy, a variety of *Bellis sylvestris*, from Mount Atlas, and other rare and interesting plants from Scotland. Mr. A. W. Wills, J.P., read Mr. J. D. Siddall's paper on "The American Water Weed, *Anacharis Alsinastrum*, its structure and habit; with some notes on its introduction into Great Britain, and the causes affecting its rapid spread at first, and apparent present diminution." The paper was illustrated by large coloured diagrams of the plant, its flowers and seeds, with sections showing its structural details; besides which Mr. J. E. Bagnall, A.L.S., exhibited specimens of the plant itself, and various sections under the microscopes. The paper was listened to with great interest by the meeting and appreciation expressed of the very able manner in which Mr. Wills had given it.—Biological Section, November 10th. Professor Haycraft exhibited a specimen of the oviduct and ovary of a fowl, and demonstrated by the aid of a diagram the process by which an egg assumes its well-known form. Leaving the ovary as a globular yellow mass (the yolk), it receives a coating of glairy fluid (the white) during its passage through the upper part of the oviduct, and then the calcareous matter (the shell) is precipitated outside that during its progress through the lower part of the oviduct. Mr. A. H. Atkins exhibited a pitcher of Nepenthes, upon which Professor Hillhouse made some interesting observations. Mr. J. Morley exhibited *Asplenium microdon*, a rare fern, which has been found only in Guernsey, near Barnstaple, and near Penzance. Mr. T. Bolton exhibited *Lucernaria auricula*, *Podura aquatica*, and *Asplanchna Brightwellii* (male and female); the latter species is the rotifer in which the male was first discovered. Mr. W. B. Grove exhibited three fungi, new to Great Britain—*Ramularia calcea*, from Hereford; *Cercospora ferruginea*, from Bradnock's Marsh; and *Stachylidium extorre*, from Harborne. On the motion of Mr. Grove, seconded by Mr. R. W. Chase, a vote of regret was passed by the meeting at the untimely death of Dr. Bull, of Hereford, so soon after the completion of his great work, "The Herefordshire Pomona." Mr. W. P. Marshall exhibited and made a few remarks upon the large botanical collection which he made during his last visit to the United States, from Arizona, California, Virginia, Niagara Falls, and the Mammoth Cave, Kentucky. The specimens were much admired.—General Meeting, November 17th. At the meeting of the Microscopical General Section, Mr. R. W. Chase read his paper on "Ornithological Notes from Norfolk," giving details of the plumage and habits of some of the rare birds he had observed, and pointing out the loss of some of the rarer kinds of birds by the drainage and cultivation of the land. In illustration of his paper he exhibited the following birds:—*Œdicnemus crepitans*, Stone Curlew; *Machetes pugnax*, Ruff; *Tringoides hypoleucus*, Common Sandpiper; *Tringa alpina*, Dunlin, all from Norfolk. Mr. T. Bolton exhibited a marine polyzoon, growing on the glass of his aquarium in Newhall Street, *Bowerbankia gracillima* (?). Mr. J. Morley exhibited the following ferns:—*Lastrea Filix-mas*, *cristata*. originally found near St. Austell, Cornwall; *Lastrea Filix-mas*, *cristata angustata*, raised from spores; *Lastrea remota*, found in Westmoreland in 1859, by Mr. F. Clowes, of Windermere, the only one found in Great Britain; *Lastrea Filix-mas*, v. *Pinderi*, found near Eller Water, in the Lake district; *Lastrea Filix-mas*, v. *Barnesii*,

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from the Lake district. He also made some interesting remarks upon the origin of species in relation to plants. Mr. W. B. Grove, B.A., exhibited *Triposporium elegans*, on decaying wood, brought by Mr. W. H. Wilkinson, from Perth. Mr. W. H. Wilkinson exhibited the following lichens:—*Parmelia caperata*, *P. Borreri*, *P. perlata*, and *Cetraria sepincola*, from U. S. America; also *Squamaria crassa*, from Nice, *Pilophoron fibula*, from Scotland, and *Parmelia perforata;* also, the fruit of *Pyrus Japonica*, from Acocks Green.—SOCIOLOGICAL SECTION. At the intermediate meeting held on Thursday, November 5th, at the Mason College, Mr. W. R. Hughes, F.L.S., President, in the chair, Mr. Alfred Browett, the Hon. Secretary, ably read Chapter VIII. of Mr. Herbert Spencer's "Study of Sociology" on "The Educational Bias," upon which an interesting discussion took place. At the ordinary meeting held on Thursday, November 19th, Mr. C. H. Allison in the chair, Mr. W. R. Hughes expounded Chapters IV. and V. of the second volume of Mr. Herbert Spencer's "Principles of Biology," which treat of the "Morphological Composition of Animals." In illustration of the subject, Mr. Hughes exhibited under the microscope, with the assistance of Mr. Thomas Bolton, F.R.M.S., a number of beautiful living specimens, which included *Amœba*, *Difflugia*, and *Foraminifera*, as showing morphological units of the first order; *Spongilla*, *Vorticella*, and *Hydra*, as showing aggregates of the second order; *Lophopus* and *Chætogaster*, as showing aggregates of the third order. Preserved specimens of corals, including *Tubipora* and *Madreporaria*, exhibited aggregates of the third order; and *Chiton*, *Octopus*, and *Amphioxus* exhibited aggregates of the second order. Mr. W. B. Grove, B.A., contributed a number of beautiful illustrations on the black board, showing embryological phases and subsequent developments. An interesting discussion followed the exposition.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY.—SECTION D, ZOOLOGY AND BOTANY. Chairman, F. T. Mott, F.R.G.S.—Monthly meeting, Wednesday, November 18th. Attendance fourteen (four ladies). The Chairman reported that the annual Fungus Foray was held on the 28th of October, when nine members of the Section, accompanied by Dr. Cooke, of London, visited Swithland Wood and Bradgate Park, collecting 118 species, of which 61 were hitherto unrecorded for the county. The party returned to the Chairman's house, where three edible species were cooked and eaten. These were *Agaricus nudus*, abundant at Hunt's Hill Spinney, near Bradgate, and of good flavour; *Hygrophorus pratensis*, and *H. coccineus*. The two latter species were not considered to be of much value. *Agaricus personatus*, commonly called "Blewitts," has been sold this autumn in some quantities, at the smaller greengrocers' shops in Leicester. There were no exhibits at this meeting. The Chairman read a short paper on "Mr. John Plant's Catalogue of Leicestershire Mollusca," which was prepared in 1850 for Mr. Potter's projected History of the County, but remained still in MS. This list contained 82 species distinctly indigenous, and four either imported or doubtfully named. One half of the species recorded had been added to the county Fauna by the researches of Mr. Plant himself. The Rev. J. Moden called the attention of the Section to a paragraph in "Science Gossip" respecting a proposed deep boring of a shaft 150 feet in diameter, which was followed by an interesting discussion.

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